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ABSTRACT

The conference proceedings on the prevention of mental retardation through improved maternity care consist of six major papers which are followed by panel discussions with two to five participants. Epidemiology of prematurity, topic of the first paper, is discussed in terms of cigarette smoking, asymptomatic bacertiuria, maternal heart volume, employment during pregnancy, maternal height and weight, birth interval, prenatal care, outcome of previous pregnancies, and definition of prematurity. The second paper focuses on prevention of obstetric antecedents, with mention of responsible parenthood, study of previous reproductive events and congenital anomalies, relationship of social status to perinatal mortality and prematurity, maternal nutrition, psychosomatic factors associated with pregnancy, maternal height and weight, maternal infections, and maternal diseases. The third paper on prevention of premature labor considers prophylaxis, early recognition of high risk patient, and inhibition of premature labor. The relative lack of medical help in encouraging the pregnant woman to enjoy both pregnancy and motherhood is the subject of the fourth paper on the low birth weight infant. The conference concludes with two short papers on specific needs to improve maternity care and a review of resources, respectively. (CB)

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Proceedings of the National Conference for the Prevention of Mental Retardation Through Improved Maternity Care

March 27–29, 1968
Washington, D.C.

New York Medical College
Department of Obstetrics and Gynecology

U.S. Department of Health, Education, and Welfare
Children's Bureau, Social and Rehabilitation Service

Proceedings of the National Conference for the Prevention of Mental Retardation Through Improved Maternity Care

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March 27–29, 1968
Washington, D.C.

EDWIN M. GOLD, M.D.
Conference Chairman and Editor

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Department of Obstetrics and Gynecology
and
U.S. Department of Health, Education, and Welfare
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Edwin M. Gold, M.D.

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INTRODUCTION: A STATEMENT OF THE PROBLEM

EDWIN M. GOLD, M.D.
Conference Chairman

I welcome you to this National Conference for the Prevention of Mental Retardation Through Improved Maternity Care.

The participants and guests convened here today are a small but totally participating group, representing expertise from several disciplines in maternal and child health. Through our interaction at this Conference, we hope to develop meaningful recommendations for action to prevent mental retardation through improved maternity care.

Why this Conference? Because mental retardation is a major national health, social, and economic problem afflicting an estimated 3 to 7 percent of our population, or nearly 6 million Americans. Because mental retardation affects 10 times more persons than diabetes, 20 times more people than tuberculosis, 600 times more people than polio, and because a retarded child is born every 5 minutes—126,000 every year. Because retarded children and adults are significantly impaired in their ability to learn and adapt to the demands of our society, and their care costs over $2.4 billion annually, exclusive of such indirect costs as public welfare expenditures and the waste of human resources. And, finally, because mental retardation is highly correlated with the same deficiencies in total maternal and infant care and with the same aspects of social and environmental pathology that are associated with decelerated rates of improvement in infant and perinatal mortality and with a rising incidence of prematurity.

Each of us is concerned with improving the quality of human reproduction. We aim to reduce infant and perinatal mortality and the incidence of mental retardation and other neurologic sequellae associated with pregnancy and parturition. In our individual endeavors, we have come to recognize a common denominator of frustration—prematurity.

Prematurity incidence in this country has increased steadily during the past 2 decades to the current level of 10 percent of births. Despite the progress of our affluent society in other areas, a 2 to 1 differential persists in prematurity incidence between our nonwhite and white populations, and we regretfully acknowledge the relationship between socioeconomic status and prematurity incidence. We are keenly aware that two-thirds of deaths in the first year of life are directly or indirectly associated with prematurity. We are also cognizant of the correlation between prematurity and mental retardation and other neurological deficits in early infancy.

It was for the purpose of exploring in depth these problems of prematurity that this Conference was developed and its format designed.

Myriads of questions require sagacious answers, and innumerable answers require verification: in relation to a changing population and its needs, in relation to changing medical technology and newer medical knowledge, and in relation to changing patterns in the delivery of health services.

What is prematurity? Why does the patient go into premature labor? What can we do about it? What do we know, or hope in the future to know, about intrauterine growth retardation? Are we satisfied with the contemporary preventive and therapeutic aspects of patient care in relation to prematurity? Is what we already know being properly applied and translated to patient care? What are the gaps in our knowledge concerning infant survival? What areas of current and future investigation should we most pursue: basic, behavioral, or service? Can we better evaluate the role of traditional maternity and newborn care? Are innovational approaches to such care necessary or desirous? Are we communicating properly, or at all? Are the obstetrician and pediatrician on the same wave length? Are other disciplines tuned in? Is the patient getting clear reception? Has the behavioral scientist been properly or sufficiently involved in our medical structure? Are accepted standards of obstetric, pediatric, and neonatal care being universally practiced?

It is to these questions that this Conference will now direct itself.

SESSION I

Epidemiology of Prematurity

Session Chairman: GERALD D. LAVECK, M.D.

EPIDEMIOLOGY OF PREMATURITY

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In a review in 1963 of the epidemiology of prematurity, I discussed the problem of definition, the incidence by maternal age, parity, race, social class, and marital status, and the relation to prenatal care, nutrition, birth interval, work during pregnancy, cigarette smoking, asymptomatic bacteriuria, and heart volume. At that time, I stated that "A critical review of the investigations reported indicates that final conclusions are unwarranted at this time. Much work needs to be done, using rigorous and sophisticated research designs, in order to determine the actual role of these and other factors in the etiology of low birth weight. The epidemiology of prematurity is yet to be elucidated." [1]

During the past 5 years, a moderate amount of investigation has been done. We are not much closer to elucidating the epidemiology of prematurity, but progress has been made in testing the validity of a number of the etiologic hypotheses and in examining the definition of prematurity more closely.

Cigarette Smoking

In 1957, Simpson[2] reported on the smoking habits of 7,499 mothers delivered at a county hospital and two voluntary hospitals in San Bernardino County, California, as determined by a questionnaire filled out in the first day or two after delivery. There was a highly significant association between prematurity and cigarette smoking during pregnancy. In the county hospital, the prematurity rate for smokers was 11.5 percent as compared with 7.8 percent for nonsmokers; the corresponding rates for the voluntary hospitals were 12.1 vs. 6.2 percent and 10.5 vs. 5.2 percent. The prematurity rate was found to be associated with the number of cigarettes smoked, and the relationship of cigarette smoking to prematurity held true regardless of maternal age.

All of the subsequent reports have tended to confirm this relationship. Lowe[3] studied 2,042 single births in six maternity hospitals in Birmingham, England, and found that the mean birth weight was significantly lower (by 170 grams) when the mothers were smokers than when they were not; that

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mean birth weight was lower when the mothers were heavy smokers (10 cigarettes or more a day) than when they were light smokers; and that the difference in mean birth weight in the smoking and nonsmoking groups was independent of maternal weight, age, and parity. No significant difference was found in duration of gestation of smokers and nonsmokers.

Frazier, Davis, Goldstein, and Goldberg[4] studied 2,736 single live births to Negro women who received prenatal care in the Baltimore City Health Department clinics and who were scheduled for delivery at the Baltimore City Hospital. Smoking histories and other data were obtained by interview in the prenatal period. The prematurity rate for nonsmokers was 11.2 percent as compared with 18.4 percent for smokers, and the rate was related to the number of cigarettes smoked daily. The difference between smokers and nonsmokers was independent of maternal age, blood group type, initial hemoglobin level, sex of child, history of work in the first trimester, education, and psychosomatic complaint score. Although the difference was significant in the multigravidas studied, it was not found to be significant in the 502 primigravidas.

The fetal death rate for smokers was 15.5 per 1,000 births as compared with 6.4 per 1,000 for the nonsmokers; the difference is statistically significant. The neonatal death rate was 27.5 per 1,000 live births for infants of smokers and 23.3 for the nonsmoker group; the difference is not significant. A record of previous stillbirths was discovered for 9.2 percent of the smoking multigravidas and 7.2 percent of the nonsmoking multigravidas; this difference is also not significant.

Herriot, Billewicz, and Hytten[5] obtained smoking histories after delivery in 2,745 mothers at the Aberdeen Maternity Hospital. They found that prematurity rates for both primigravidas and multigravidas were higher for smokers than for nonsmokers in each of three social classes. They further divided the women in each social class into three groups according to height. The prematurity rate, they stated, was higher for smokers than for nonsmokers in each height-social class grouping. They were unable to demonstrate a correlation between prematurity and the number of cigarettes smoked. Smokers had a slightly shorter gestation period. At each week of gestation, regardless of parity, the mean birth weight was lower in the infants of smokers than in the infants of nonsmokers.

Savel and Roth[6] queried 1,415 patients at the Newark Beth Israel Hospital immediately after delivery. The prematurity rate was 2.6 percent in white nonsmokers and 7.0 percent in white smokers; 9.6 percent in Negro nonsmokers and 15.0 percent in Negro smokers. The rate increased with the number of cigarettes smoked. The difference in mean birth weight was about 230 grams for whites and 140 grams for Negroes. Average duration of pregnancy was not significantly different for smokers and nonsmokers. Stillbirth and neonatal death rates were not influenced by smoking.

Zabriskie[7] obtained postpartum smoking histories from 2,000 women at the U.S. Army Hospital in Honolulu. He found a mean difference in birth weight of 229 grams between infants of smokers and nonsmokers. The prematurity rate was 3.8 percent in 1,043 nonsmokers and 9.9 percent in 957 smokers, and the rate increased with the amount smoked. The nonsmokers gave a history of having aborted 8.8 percent of 2,850 gestations, while the smokers had aborted 12.6 percent of 2,769 gestations; the difference is statistically significant.

O'Lane[8] studied 1,031 white women delivered at the U.S. Naval Hospital in San Diego, California. The prematurity rate was significantly higher in 465 smokers (11.8 percent) than in 566 nonsmokers (5.1 percent). The length of gestation in the two groups was not significantly different. The mean crown-heel length of infants of smokers was significantly less than that of nonsmokers' infants. The proportion of all gestations which had aborted was significantly higher in smokers (12.6 percent) than in nonsmokers (8.9 percent). There were no significant differences in the fetal and perinatal death rates of the two groups.

Yerushalmy[9] studied 5,334 white and 1,413 Negro women in the Kaiser Foundation Health Plan in the San Francisco-East Bay area. Interviews were obtained in the prenatal period. The prematurity rates were significantly higher in smokers: 6.4 percent in white smokers and 3.5 percent in white nonsmokers; 13.4 percent in Negro smokers and 4.9 percent in Negro nonsmokers. At each gestational age, infants of smoking mothers weighed less than infants of nonsmoking mothers. The incidence of single live births of short gestation was only slightly, and not significantly, higher for smokers than for nonsmokers.

The overall neonatal mortality rate was the same for infants of smoking and nonsmoking mothers. For infants premature by weight, the neonatal mortality rates were substantially and significantly lower for infants of smoking than of nonsmoking mothers. For infants premature by gestation (less than 37 weeks from LMP), there were no significant differences in neonatal mortality rates by smoking status. For infants premature both by weight and gestation, the neonatal mortality rates were again substantially and significantly lower for infants of smoking than of nonsmoking mothers. Yerushalmy suggested that the explanation of these results may be found in the smoker and not the smoking. He recognized, however, that the findings are also consistent with the hypothesis that smoking causes a reduction in the size of the infant without increasing its risk of neonatal death.

Simpson[10] questioned women attending prenatal clinics in Lancashire at the first visit. The incidence of prematurity was 3.3 percent in the 754 nonsmokers and 7.0 percent in the 603 smokers. The mean birth weight for infants of nonsmokers was 7 lb. 14 oz. as compared with 7 lb. 5½ oz. for those of smokers. He found also that smoking did not vary by social class as determined by the husband's occupation.

Underwood, Hester, Laffitte, and Gregg[11] studied 4,440 puerperal women at the Medical College of South Carolina and Roper Hospitals and found that the prematurity rate increased with the number of cigarettes smoked. The difference in mean birth weight between infants of nonsmokers and infants of heavy smokers (more than one pack a day) was 353 grams for white private patients, 213 grams for white ward patients, and 115 grams for Negro ward patients. The abortion rate was found to be slightly increased among smokers, but the stillbirth rate was not affected.

Reinke and Henderson[12] studied 3,156 Negro women who delivered single live infants at University Hospital in Baltimore. Data on smoking were obtained at the time of registration for prenatal care. The mean birth weight was 148 grams higher in the 1,542 nonsmokers than in the 1,614 smokers. The prematurity rate was 10.6 percent in nonsmokers and 16.7 percent in smokers, but the mean gestation was identical (37.7 weeks) in the two groups.

Peterson, Morese, and Kaltreider[13] studied 7,740 white women delivered in 17 Air Force hospitals; excluded were patients with complications and multiparas with a previous premature birth. The incidence of prematurity was 3.8 percent among the 4,455 nonsmokers (1.3 percent premature both by weight and gestation) and 6.0 percent among the 3,285 smokers (2.0 percent premature ,both by weight and gestation). No difference was found in perinatal mortality for the two groups.

MacMahon, Alpert, and Salber[14] obtained smoking data by mail questionnaires to mothers of single white legitimate live births in Massachusetts; included were 6,232 nonsmokers and 5,923 smokers. For both sexes, the difference in mean birth weight between the offspring of nonsmokers and those of smokers of two packs of cigarettes per day was about 10 ounces. The decrease in birth weight with increasing amount smoked was found in all parity groups. The mean weights of infants of women who smoked before, but not during, the pregnancy did not differ significantly from those of women who had never smoked. Furthermore, higher birth weights were found for the offspring of mothers smoking less during pregnancy than they had before, by comparison with those who continued at the same rate.

Yerushalmy[15] reported an association of fathers' cigarette smoking with prematurity. Goldstein, Goldberg, Frazier, and Davis[16] have pointed out, however, that there is an association between smoking habits of spouses, and that in Yerushalmy's data the difference in prematurity rates between smoking fathers and nonsmoking fathers, independent of mothers' smoking habits, is not significant. In the study by MacMahon, Alpert, and Salber,[14] it was found that fathers' cigarette smoking habits are not associated with infant birth weight when the data are adjusted for mothers' smoking habits. Terris and Gold [17] studied 197 premature births and an equal number of control births of Negro ward patients, matched by sex and birth order of the infant, and age and marital status of the mother. There were no significant differences in husbands' cigarette smoking. On the other hand, a significantly higher proportion of mothers of prematures were found to have smoked during pregnancy.

Comstock and Lundin[18] studied all identifiable stillbirths and infant deaths, and a 3 percent sample of live births in Washington County, Maryland, occurring during the 10 years preceding a special census of all households in the county. This census included information on the smoking history of county residents, and it was possible, therefore, to obtain the smoking status of parents at the time of birth of each child. (It was recognized that smokers who abstained during pregnancy are classified as smokers by this procedure.) The median weight of infants born to 238 nonsmoking mothers was higher by 200 grams than those born to 138 smokers, and the entire distribution of birth weights of infants of smoking mothers was shifted to the lower end of the scale by about the same amount. Median birth weight when neither parent smoked was 3,477 grams, almost the same (3,435 grams) if only the father smoked, and 3,223 grams if both parents smoked. Stillbirths per 1,000 live births (with live births estimated by multiplying the number in the sample by 33) showed no significant differences according to the smoking history of the mother. Neonatal death rates per 1,000 estimated live births were definitely higher among infants born to smoking mothers, but the excess mortality was almost entirely limited to infants whose fathers had a grammar school education or less.

On the basis of the studies so far reported, it may be concluded that cigarette smoking during pregnancy is definitely related to prematurity. It is not associated with premature labor, but with decreases in the birth weight of infants for every given period of gestation. The relation of cigarette smoking to fetal and neonatal mortality is still not determined.

Asymptomatic Bacteriuria

In 1959, Kass[19] reported that women with asymptomatic bacteriuria had a high incidence of premature births and that effective treatment, which rendered women free of bacteriuria until delivery, removed the added risk of prematurity. The data[20] follow:

	Number of deliveries	PREMATURE BIRTHS	
		Number	*Percent*
Bacteriuric, placebo	95	26 *	27
Bacteriuric, treated	84	6	7
Nonbacteriuric	1,000	88	9

* Includes three deliveries of twins

The difference between the placebo and treated groups is significant at the 1 percent level, even when the twins are excluded.

Kass[20] had previously studied 4,000 women making their first prenatal visit to the Boston City Hospital; he found the occurrence of asymptomatic bacteriuria to be 6 percent. Clean voided specimens were used, and bacteriuria was defined as the presence of 100,000 or more bacteria per ml. of urine in two successive specimens. Patients who were in the eighth and ninth months of pregnancy at the first prenatal visit were not included. Kass[21] reported that "the incidence of bacteriuria is about the same from the second to the seventh months of pregnancy. Thus the bacteriuria was acquired before the second month of pregnancy, and acquisition of bacteriuria after the second month would appear to be uncommon, if it occurs at all."

Kass[21] also found that the occurrence of bacteriuria increases with both parity and age of the mother. No data are presented on the relation of asymptomatic bacteriuria to race and marital status.

Prematurity is known to be related to age, parity, race, marital status, and economic level.[1] Since asymptomatic bacteriuria was found by Kass to be related to age and parity, and conceivably might be related also to race, marital status, and economic level, any association found between bacteriuria and prematurity might be a secondary association based on a primary relationship to one or more of these other factors. Kass did not report on the comparability of the bacteriuric and nonbacteriuric women with regard to these variables.

The bacteriuric women were assigned to placebo and treated groups on an alternating basis. This procedure, unfortunately, does not guarantee that the two groups will be comparable for other relevant factors such as age, parity, race, marital status, and economic level. Alternate assignment to treatment and control groups should, if the series is large enough, result in groups which are more or less comparable with regard to other characteristics. This may not happen, however, and it is, therefore, incumbent on the investigator to assess his groups for comparability for relevant factors; any differences found must be taken into account in the analysis and interpretation of differences in outcome. No data on comparability of placebo and treated groups are presented in Kass' reports.

A large number of investigators have attempted to confirm Kass' results. To date, only one of 19 reports has unequivocally confirmed his finding of a significantly higher prematurity rate in women with asymptomatic bacteriuria. Stuart, Cummins, and Chin[22] collected clean voided specimens of urine at the first visit to the prenatal clinics of the University College Hospital in Jamaica. Two or more consecutive counts of 100,000 or more bacteria per ml. of urine were regarded as indicative of significant bacteriuria. Positive findings were obtained in 95, or 3.5 percent, of 2,713 subjects. Of the 88 women with bacteriuria followed to term, 20 (22.8 percent) had premature infants. Of the first 729 consecutive controls followed to term, 83 (11.4 percent) had premature infants. The difference is significant at the 1 percent level. The higher prematurity rate for women with bacteriuria was found in all age groups. However, no analysis was made of the comparability of the women with and without bacteriuria in terms of parity, marital status, or economic level.

Three other reports[24,25,26] have been cited [23] as supporting Kass' findings. Careful examination of these reports, however, discloses that this judgment is unwarranted. Layton,[24] for example, studied 1,000 patients in the Princess Mary Maternity Hospital in Newcastle upon Tyne. All patients attending the prenatal clinic before the 32nd week of pregnancy were included. Midstream urine samples were taken, and the usual criterion (two consecutive samples with 100,000 or more organisms per ml.) was used. For each bacteriuric patient, the controls were the next two patients by registration number. He found a prematurity rate of 16.9 percent in 63 bacteriuric women and 8.9 percent in 114 controls. The difference, however, is not statistically significant ($X^2 = 2.1$, $.10<P<.20$).

Layton identified a factor other than sampling variation which could account for the difference in prematurity rates. Of the 63 bacteriuric women,

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39.9 percent were found to be in social classes IV and V (semiskilled and unskilled laborers), while only 17.8 percent of the 114 control women, and 13.2 percent of 2,020 women delivered in the hospital in 1960, were in these social classes. One would, therefore, expect a higher prematurity rate in bacteriuric women simply because of the well-known relationship of prematurity to social class.

Kincaid-Smith and Bullen[25] took midstream specimens of 4,000 women at the first prenatal visit to the Queen Victoria Hospital in Melbourne, Australia. Only patients who attended before 26 weeks of gestation were included. The usual criterion of two consecutive counts of 100,000 organisms per ml. was used. The prematurity rate was 5.0 percent in 500 nonbacteriuric women, 21.5 percent in 56 bacteriuric women who were randomly placed on placebo tablets, and 17.3 percent in 52 bacteriuric women who had been randomly placed on drug treatment and were rendered free of bacteriuria until delivery. The prematurity rates are significantly higher in the bacteriuric women, but there is no significant difference between the successfully treated as opposed to the placebo group.

These findings clearly point to the likelihood that the association found by these authors between bacteriuria and prematurity was a secondary one. Otherwise, successful elimination of bacteriuria would have reduced the prematurity rate as in Kass' series.

Another issue related to experimental design is illustrated by the work of LeBlanc and McGanity[26] in Galveston, Texas, who used catheterized urine specimens taken at the first clinic visit; a single count of 100,000 organisms per ml. was the criterion. The prematurity rate was 11.6 percent in 1,141 nonbacteriuric women, and 22.1 percent in 27 untreated bacteriuric women; the difference is barely significant at the 5 percent level ($X^2 = 3.84$, $P = .05$).

In 101 treated bacteriuric women, the prematurity rate was 6.9 percent; the difference from the rate for the untreated bacteriuric women is significant at the 2 percent level. However, it should be noted that this comparison is between treated and untreated women, not between those cured of their bacteriuria versus untreated women and treatment failures. The latter is the only valid comparison. The importance of this point is indicated by the authors' finding that a negative culture at delivery was found in 50 percent of the untreated bacteriuric women, 63 percent of the untreated and drug discontinued groups, and 79 percent of the women with continuous drug therapy.

A good example of the necessity of assuring comparability of cases and controls for other relevant factors is provided by the work of Henderson and her colleagues. In a priliminary report, Henderson, Entwisle, and Tayback [27] presented the findings of a study which used catheterized urine specimens taken in the delivery room at the University Hospital in Baltimore. They found the prevalence of bacteriuria to be 3.2 percent for white private patients, 9.9 percent for white ward patients, and 7.3 percent for Negro ward patients. For Negro patients, the prematurity rate (including single births only) was 23.3 percent for 73 bacteriuric mothers, as compared with 14.8

percent for 921 nonbacteriuric mothers; this difference is not significant. In white patients, the rate for 39 bacteriuric mothers was 17.9 percent, as compared with 6.6 percent for 604 nonbacteriuric mothers; the difference is significant at the 1 percent level. The data for the white mothers are not presented separately for ward and private patients, although the prevalence of bacteriuria was markedly different in the two groups. Ward patients comprised 69.2 percent of the bacteriuric mothers and only 40.6 percent of the nonbacteriuric mothers. The difference in prematurity rates, therefore, may reflect, at least in part, the effect of socioeonomic status. No data on comparability by age, parity, or other relevant factors are provided for the white women in the bacteriuric and nonbacteriuric groups.

In a subsequent report, Henderson[28] presented the results of a study of 7,161 women screened for bacteriuria on registration in the prenatal clinic at the University Hospital. No private patients were included in this study. Significant bacteriuria was defined as 100,000 or more gram-negative organisms in two consecutive clean-caught midstream urine specimens. The second specimen was always collected within 1 week of the first. The prevalence of significant bacteriuria was found to be 5.1 percent among 6,250 Negro women and 4.8 percent among 911 white women. The prematurity rate for single live born infants was 12.1 percent for Negro women with bacteriuria and 14.7 percent for those who were negative; for white women, the rate was 6.8 percent for those who were bacteriuric and 10.9 percent for those who were not.

In addition, each woman who had significant bacteriuria at prenatal registration was matched with one who did not on all the following variables: race, smoking habits, infant sex, maternal age, number of previous pregnancies, weeks of gestation at prenatal registration, and preconception weight/height ratio. Prenatal and obstetric records of the bacteriuric women and their matched controls were reviewed and abstracted by a physician who did not know the urinary status of the patients. Three hundred and twenty-eight pairs of women had single live infants born at University Hospital. On the average, the infants of the bacteriuric women were 40 grams heavier than the infants of the control women, and the bacteriuric women had pregnancies 0.78 percent of a day longer than the control women. The differences are not significant.

These data indicate that the original finding by Henderson and her colleagues of a significant increase in prematurity in bacteriuric white patients was probably due, at least in part, to the fact that ward patients, who would be expected to have higher prematurity rates then private patients, comprised 69 percent of the bacteriuric mothers and only 41 percent of the nonbacteriuric mothers.

There are eight additional reports, [29-36] in which no attention was paid to the comparability of case and control groups, that were unable to confirm an association between asymptomatic bacteriuria and prematurity. Two of these reports[35,36] were also unable to confirm Kass' finding that treatment reduces the incidence of premature births.

Turck, Goffe and Petersdorf [29] obtained catheterized urine samples at the

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time of delivery. The incidence of bacteriuria was 8.6 percent in 195 Negro patients, 5.1 percent in 375 white county hospital patients, and 1.9 percent in 1,074 white private patients. Premature births occurred in 9.7 percent of the patients with bacteriuria (county hospital, 13.9 percent; private, 4.3 percent) and 5.5 percent of the patients without bacteriuria (county hospital, 9.4 percent; private, 3.7 percent). None of these differences between bacteriuric and nonbacteriuric women is statistically significant.

Schamadan[30] collected clean voided urine specimens from prenatal patients at the Ohio State University Health Center. The usual criterion of bacteriuria was used. The prematurity rate was 14.3 percent in 56 bacteriuic women and 11.8 percent in 755 nonbacteriuric women.

Forkman[31] of the University of Lund, Sweden, studied 595 women seen in the prenatal clinic. Noncatheterized urine specimens were taken, and the criterion of 100,000 organisms per ml. was used. The prematurity rate was 3.4 percent in 561 nonbacteriuric women and 2.9 percent in 34 women with asymptomatic bacteriuria. It should be noted, however, that Forkman does not indicate whether the usual criterion of bacteriuria (two consecutive positive specimens) was used.

Hoja, Hefner, and Smith[32] studied 1,000 women seen in the prenatal clinic of an Army general hospital. They used single catheterized urine specimens taken on initial visit and also at delivery. The incidence of prematurity was 6.2 percent in 857 nonbacteuriuric women and 7.0 percent in 143 bacteriuric women. The inconstancy of bacteriuria in pregnancy is demonstrated by the finding that only 22 of these 143 women had bacteriuria at both initial visit and delivery; 49 were positive at initial visit only, and 72 were positive only at delivery. The incidence of prematurity in these three groups was, respectively, 4.5, 8.1, and 6.9 percent.

Wilson, Hewitt, and Monzon,[33] of the University of California at Los Angeles, using prenatal midstream urine specimens and the usual criterion of significant bacteriuria, compared the outcome of pregnancy in 230 bacteriuric women (145 asymptomatic, 85 symptomatic) and 6,216 women in the prenatal clinic population. The incidence of prematurity was 11.3 percent in the bacteriuric women and 9.7 percent in the clinic population from which the bacteriuric women were selected.

Prát, Hatala, Beer, and Vágnerová[34] made repeated collections of noncatheterized urine specimens at roughly 1-month intervals during pregnancy in all women who attended three prenatal clinics in Prague district 4. The usual criterion for bacteriuria was used. For 54 women with bacteriuria, the mean duration of pregnancy was 276.1 days; 7.4 percent of the pregnancies lasted 22 weeks or less; the mean birth weight of infants was 3,376 grams; and the prematurity rate was 5.9 percent. For 674 women without bacteriuria, the mean duration of pregnancy was 277.7 days; 4.7 percent of the pregnancies lasted 22 weeks or less; the mean birth weight of infants was 3,314 grams; and the prematurity rate was 5.6 percent.

Little[35] studied 2,028 women attending the prenatal clinics at Charing Cross Hospital and Fulham Maternity Hospital in London. Urine specimens were collected by a clean-catch technique, and the usual criterion for bacteriuria was used. Of the 1,916 nonbacteriuric women, 149 (7.8 percent) had premature infants, while only 3 (2.8 percent) of the 109 bacteriuric women had premature infants. The bacteriuric women were randomly assigned to treatment and control groups; the mean birth weight was 7 lb. 6-⅗ oz. in the treated women, and 7 lb. 4-⅘ oz. in the women with untreated bacteriuria.

Gold, Traub, Daichman, and Terris[36] studied 1,281 prenatal clinic patients at the Jewish Hospital of Brooklyn. Midstream urine specimens were collected from every patient in the study at each antepartum visit until delivery. The usual criterion for bacteriuria was used. Bacteriuric women were randomly assigned to treatment and control (placebo) groups. Of the 1,216 nonbacteriuric women, 168 (13.9 percent) had premature infants. There were no premature infants among the 30 untreated bacteriuric women, and there were two (5.7 percent) among the 35 treated bacteriuric women.

The continuing examination of all patients throughout pregnancy, whether bacteriuric or not, disclosed some interesting findings. Kass' statement that "acquisition of bacteriuria after the second month would appear to be uncommon, if it occurs at all" was not confirmed. Of the 65 bacteriuric women, 19 became bacteriuric two to seven visits after their first clinic visit; in 15 of these 19 patients, bacteriuria did not appear until the third trimester of pregnancy. Many investigators have limited the discovery of bacteriuria to the first prenatal visit. If a similar policy had been followed in this study, 29 percent of the cases of asymptomatic bacteriuria would not have been diagnosed.

Of the 35 treated patients, 65.7 percent reverted to bacteriologically negative status before delivery. Of the 30 control (placebo) patients, 26.6 percent reverted to bacteriologically negative status before delivery. These findings underscore the hazards of comparing treated versus untreated patients without regard to bacteriological outcome.

Two of the 18 negative reports on asymptomatic bacteriuria and prematurity are from studies of unmatched series in which the comparability of cases and controls for age and parity is noted. Low, Johnston, McBride, and Tuffnell [37] used catheterized urine specimens taken at the initial prenatal visit to the Toronto General Hospital. Among 80 women with positive cultures, the average age was 28 years, 41 percent were primiparas, 2.5 percent had a late abortion with delivery prior to 20 weeks' gestation, 4.2 percent had premature labor (less than 37 weeks), 6.0 percent had premature infants (2,500 grams or less), and 2.5 percent had perinatal deaths. Among 691 women with negative cultures, the average age was 25 years, 38 percent were primiparas, 3.2 percent had a late abortion with delivery prior to 20 weeks' gestation, 5.2 percent had premature labor, 7.8 percent had premature infants, and 3.0 percent had perinatal deaths.

Sleigh, Robertson, and Isdale[38] used midstream specimens from women attending the prenatal clinic of the Royal Infirmary in Edinburgh. The criterion for significant bacteriuria was a single count of 1,000,000 organisms per ml. or two consecutive counts of 100,000 organisms per ml. Of the 1,684 patients examined, 111, or 6.6 percent, had asymptomatic bacteriuria. The first hundred of these were compared with 100 controls selected at random from the nonbacteriuric women. The mean age was 27.0 in the bacteriuric group and 27.1 in the controls; 63 percent of the bacteriuric group were primigravidas as compared with 61 percent of the controls. There were seven infants in each group who were premature (2,500 grams or less), but, although the seven infants in the control group survived, there were two stillbirths and one neonatal death in the infants born to mothers with bacteriuria.

Finally, in addition to the second report by Henderson,[38] there are three negative reports which are based on studies in which bacteriuric and nonbacteriuric women were matched on a number of relevant variables. Bryant, Windom, Vineyard, and Sanford [39] studied 448 women at the Parkland Memorial Hospital in Dallas, Texas. Clean voided specimens were obtained at the first prenatal clinic visit and at each return visit; the criterion for significant bacteriuria was 100,000 or more organisms per ml. in at least three separate anterpartum specimens. Significant bacteriuria was consistently present in 32 (7.1 percent) of the 448 women. Forty-four women of similar age, race, socioeconomic background, and multiparity, and who had consistently negative urine cultures, were selected for comparison. The prematurity rate was 5.7 percent in the bacteriuric women and 8.7 percent in the controls.

Norden and Kilpatrick[40] studied 1,703 women at the Grady Memorial Hospital in Atlanta, Georgia. Clean voided specimens were taken at the initial clinic visit; the usual criterion for bacteriuria was used. Each bacteriuric woman was matched with a control by race, age, previous number of pregnancies, trimester of present pregnancy, and past history of abortion or premature delivery. The prematurity rate was 12.5 percent in 88 deliveries of women with asymptomatic bacteriuria and 12.8 percent in 109 control deliveries.

Whalley[41] studied 4,357 women at the Parkland Hospital in Dallas, Texas. Clean voided urine specimens were collected at the initial clinic visit; the usual criterion for bacteriuria was used. The occurrence of bacteriuria was found to increase with age and with parity; these are variables which are known to be associated with prematurity. Whalley, therefore, matched each subject in whom bacteriuria was detected prior to the 28th week of gestation with a patient of similar age, race, and parity whose initial urine culture contained less than 1,000 organisms per ml. At the time of delivery, a catheterized urine specimen was obtained from each subject in the control group; if this urine contained more than 1,000 organisms per ml. of urine, the patient was not included in the control series. There were 179 bacteriuric women seen prior to the 28th week of gestation who had consistently positive cultures at all prenatal clinic visits and at delivery. Of these, 176 delivered a single birth; the prematurity rate was 14.8 percent as compared with 11.9 percent in the 176 matched controls. The difference is not significant.

This lengthy review may be concluded with a brief statement: the evidence is overwhelming that there is no relation between asymptomatic bacteriuria and prematurity.

Maternal Heart Volume

Unnérus[42] of the University of Helsinki measured maternal heart volume radiologically on the day after delivery. A heart volume under 500 cc. was found in 19.5 percent of 203 mothers of premature infants and in 5 percent of 578 mothers of mature infants; the volume was under 600 cc. in 61.5 percent of the former and in 32 percent of the latter.

Reasoning that the pregnant woman's work capacity is related to her heart volume and that prematurity occurs when the workload of the pregnant woman exceeds her capacity, Unnérus examined prenatal clinic patients at the end of the fifth, seventh, and nine months. He advised all those with heart volumes under 320 cc. per square meter of body surface area to avoid heavy work and to rest for some hours every day. He reports that in 90 such cases, only one premature infant was born.

These findings were confirmed by Boesen and Gudbjerg[43] of the University of Copenhagen. Of 27 women delivered before the 250th day of gestation, 16, or 59.3 percent, had a heart volume below 500 ml.; this was true for only 5, or 19.2 percent, of 26 women delivered after the 250th day. The difference is significant at the 1 percent level. Similarly, 20, or 54.1 percent, of 37 women with infants of 2,500 grams or less had a heart volume below 500 ml. as compared with 4, or 21.1 percent, of 19 women with mature births. The difference is significant at the 2 percent level.

Hedberg and Radberg[44] of the University of Gothenburg in Sweden were unable to confirm these findings. Using the same method of determining heart volume, they studied 80 mothers of premature infants and an equal number of mothers of full-term infants 2 days after delivery. Only normal single pregnancies were included, and the mothers of the full-term infants were randomly selected. The heart volume was under 500 cc. in 23 percent of the mothers of premature infants and 18 percent of the mothers of full-term infants. The difference is not significant.

Robbe and Rune[45] in Stockholm studied 39 pregnant women with small heart volumes. The mean heart volume was 450 ml., or 277 ml. per square meter of body surface area. The prematurity rate in this group was only 5.1 percent.

These studies ignored the likelihood that the mothers of premature infants do not resemble the mothers of mature infants in age, parity, race, social class, and marital status. Since maternal heart volume may well be influenced by such factors as age, race, and social class, it is evident that any differences found in the heart volume of mothers of premature and mature infants may be related to these factors rather than to the state of maturity of their newborn infants.

In order to obviate this difficulty, Terris, Gold, Schwartz, and Hall[46] undertook to confirm the relation of heart volume and prematurity by using a series in which cases and controls were matched on factors known to influence the incidence of prematurity. The study was done at the Jewish Hospital of Brooklyn and included premature births of Negro ward patients with no known cause of prematurity. For each premature infant, the control was the next mature birth to a Negro ward patient which matched by sex and birth order of the infant and age and marital status of the mother. Heart volume was determined radiologically on the second or third day after delivery.

In the first 100 pairs studied, it was found that 18 mothers of prematures and 10 control mothers had heart volumes under 500 cc. It was also found, however, that the postpartum weight was under 110 pounds in 14 mothers of prematures and 3 control mothers, while the body surface area was under 1.5 square meters in 16 mothers of prematures and 6 control mothers. When heart volume per square meter of body surface area was used in the comparison, no difference was found. While 11 mothers of premature infants had a heart volume below 300 cc. per square meter, this was true also for 9 of the control mothers. In the completed series of 167 pairs, the volume per square meter was below 300 cc. in 10.[illegible] percent of the mothers of prematures and in 7.8 percent of the controls.

These data indicate that the mothers of premature infants tend to weigh less than the mothers of mature infants, and their heart volume tends, therefore, to be smaller. Thus, a weight below 110 pounds, or a body surface area below 1.5 square meters, appears to identify the mothers of premature infants quite as well as does a heart volume below 500 cc.; none of these characteristics, however, identifies a significant proportion of the total. These findings raise the question of whether any additional information on the risk of premature birth is obtained by measuring maternal heart volume.

Backman and Unnérus[47] have published data which are consistent with this interpretation. In an investigation of 530 mature and 174 premature infants, they determined the mothers' height, weight, and heart volume on the day after delivery. The mothers of the premature infants had significantly lower weights and heart volumes than the mothers of the mature infants, but there was no significant difference for maternal height. Maternal heart volume showed a highly significant correlation with both maternal weight and height. Also, Ihrman[48] has reported a positive correlation of maternal heart volume with weight and with body surface area. These findings reinforce the view that differences in maternal heart volume between mothers of premature and mature infants probably reflect differences in maternal weight and, therefore, body surface area, rather than an independent association of small maternal heart volume and prematurity.

There have been two small prospective studies of the relation of maternal heart volume to prematurity. Bishop[49] at the Pennsylvania Hospital in Philadelphia measured heart volume on the second postpartum day and found that 18 of 30 mothers of premature infants had volumes below 500 cc. as compared with only 4 of 30 control mothers. He then measured the heart volume of 300 consecutive and unselected normal obstetric patients at about the 27th week of gestation and reported that the incidence of prematurity was inversely related to heart volume. Bishop also states that "the entire series was further analyzed using not only the main variables of maternal heart size but the control variables of height, weight, age, and hemoglobin levels. While all of these factors may have some effect upon the incidence of prematurity, in all analyses, the patients with less than average heart size in each instance had an associated increased incidence of prematurity." No data from these analyses are presented.

Hytten, Paintin, Stewart, and Palmer[50] in Aberdeen studied an unselected sample of 109 married primigravidas attending a prenatal clinic. Heart volume was measured radiologically at 30 weeks. They found that height was related to heart volume ($\rho = 0.30$) and to birth weight ($\rho = 0.27$). An initially weak association between heart volume and birth weight ($\rho = 0.12$) disappeared completely when the effect of height was taken into account. No data were presented on maternal weight. Only three women delivered before the 38th week of gestation, and they went into labor spontaneously for no apparent reason at 35, 36, and 37 weeks; the heart volume was above 700 cc. in each case. Only four women had a heart volume of 320 cc. per square meter or less; none of them delivered premature infants.

Hytten and his coworkers raise the possibility, nevertheless, that a small woman, with her smaller heart and smaller blood volume, may have insufficient reserve to cover both the demands of pregnancy and of hard physical work. They point out that their subjects were all primigravidas whose domestic commitments were relatively light, and that physical work contributed little to the demands on their circulatory system. They suggest that "it would be of great interest to know whether, in a society where women were obliged to perform hard physical work during pregnancy, heart volume rather than body size limited foetal growth or whether, as one might expect, heart size would increase to cope with requirements. In this society, at least, the measurement of heart volume as an aid to the prevention of prematurity is of no value."

A large-scale prospective study has been reported by Kauppinen[51] for mothers registered in the maternity welfare clinics of Helsinki. In 5,558 women, he found that the prematurity rate decreased with increased maternal absolute heart volume; this was true for both primiparas and multiparas. Maternal relative heart volume, i.e., volume per square meter of body surface area, was found to be related to prematurity in primiparas but not in multiparas. The data follow:

	PRIMIPARAS		MULTIPARAS	
Maternal relative heart volume (cc./sq.m)	*No. infants*	*Percent premature*	*No. infants*	*Percent premature*
Small (380 and under)	1,137	8.5	815	4.3
Medium (385–450)	5,482	4.6	4,788	4.0
Large (455 and over)	1,318	3.9	1,482	3.4
Total	7,937	5.1	7,085	3.9

No analysis was made of the comparability of the primiparas in the three heart volume groups with respect to other factors known to be associated with prematurity. However, data are given for a group of 287 primiparas aged 20 to 29 whose weights and heights were close to the mean (weight 60 to 64 kg. and height 160 to 167 cm.). In this small series, in which there was relative homogeneity with regard to age, parity, weight, and height, no relation was demonstrated between maternal heart volume and prematurity. The data follow:

Maternal absolute heart volume (cc.)	*No. infants*	PREMATURES *No.*	*Percent*
595 and under	53	3	5.7
600–695	150	8	5.3
700 and over	84	1	1.2
Total	287	12	4.2

The evidence available to date fails to provide convincing support for the hypothesis that maternal relative heart volume is associated with prematurity.

Employment During Pregnancy

Douglas[52] examined the effect of gainful employment during pregnancy in a study of 13,257 single legitimate births of known weight occurring in Great Britain during a single week in March 1946. For first births to mothers in the working class, he found that the prematurity rate for mothers leaving work 11 or fewer weeks before delivery was 13.7 percent, as compared with 10.0 percent for those leaving work 12 to 19 weeks before delivery, and 6.0 percent for those leaving work 20 or more weeks before delivery; the differences are significant at the 1 percent level. Since these differences might arise from the shorter duration of pregnancy for premature births as well as from differences in demographic factors, Douglas examined this question further by using the expected date of delivery and matching each premature with a mature birth by sex, birth order, social class, overcrowding, mother's age, and geographical location. He found that 35 percent of the mothers of premature infants were working during the last 15 weeks before the expected date of delivery, as compared with only 18 percent of mothers of the matched controls.

Stewart[53] obtained similar results in a smaller series of 1,318 single first births in Northamptonshire during 1952. The prematurity rate was 4.7 percent for 780 housewives, 8.4 percent for 285 women gainfully employed for less than 28 weeks of pregnancy, and 11.1 percent for 253 women gainfully employed 28 weeks or more; the differences are significant at the 1 percent level. In order to rule out the effects of other variables, Stewart also used matched samples. In a group of 143 women employed for less than 28 weeks and an equal number of housewives, matched for age, social class, and marital status, the incidence of prematurity was 4.9 percent for the employed women and 2.1 percent for the housewives; this difference is not significant. In a group of 152 women employed for 28 weeks or more and an equal number of housewives, the corresponding rates were 7.3 and 1.3 percent; this difference is significant at the 1 percent level.

Some doubt is cast on these studies by the work of Ferguson and Logan,[54] who investigated 350 employed and an equal number of nonemployed

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women in Glasgow whose youngest child had been born about 7 months previously. More of the nonemployed women lived in homes of their own; they also paid slightly higher rents. The level of home assessment, as made by an experienced social worker, was higher for the women who were not employed. These findings raise the question of whether matching by social class is sufficient to insure comparability of economic status; there are considerable differences within each of the five social classes customarily used in Great Britain.

Illsley, Billewicz, and Thomson,[55] in a preliminary investigation, determined that in Aberdeen, in each social class, married primiparas who worked beyond the 20th week of pregnancy had a higher rate of prematurity than those who stopped work earlier. The data follow:

INCIDENCE OF PREMATURITY BY PERIOD OF WORK DURING PREGNANCY

Social class	*Under 21 weeks*	*21 weeks or more*	*Total*
I, II	3.6 percent	10.0 percent	4.9 percent
III	4.4	13.9	7.1
IV, V	7.6	10.6	8.9

They reasoned, however, that women who had to work during pregnancy might have lower standards of living than those who did not. An analysis of data for the married primiparas delivered at the Aberdeen Maternity Hospital showed that women in the poorer social classes, women of short stature, and women aged 15 to 19 at the time of delivery were more likely to work during the second half of pregnancy. They, therefore, matched the mothers of prematures with control mothers by social class, height, age, timing of marriage (pre- or postmarital conception), and type of work done during or before pregnancy. The prematures were limited to legitimate single births of primiparas resident in the city of Aberdeen, excluding those in which there was an obvious clinical explanation of the prematurity. In order to increase the contrast between the premature and nonpremature groups, the controls were limited to infants weighing between 6½ and 8½ pounds.

The matched groups showed little or no difference in average duration of prenatal care, in housing conditions, or in domestic responsibility. As may be seen from the following table, there was also no difference in duration of work during pregnancy.

Week of pregnancy in which work ceased	*Prematures*	*Controls*
0–20	65	69
21–26	12	10
27 +	26	24
Total	103	103

Since manual work might impose a greater strain than nonmanual work and might, hence, be deleterious, the analysis was repeated for the 82 pairs of manual workers and shop assistants. Again, there was no difference in duration of work between the premature and control groups.

Martin[56] studied 1,097 primiparous mothers of premature infants born in Greater London and Southeast Lancashire. The data were obtained by health visitors who interviewed the mothers with a standard questionnaire. Each case in the premature series was matched with a control of the same age and social class. In both groups, 78 percent of the mothers were gainfully employed during pregnancy. There were no differences in type of work; for example, 38.3 percent of the mothers of prematures and 35.6 percent of the control mothers were factory operatives. The average week of pregnancy at which employment ceased was 25.6 weeks for mothers of premature births and 25.8 weeks for the control mothers. Employment after the 30th week of pregnancy occurred in 27.9 percent of the mothers of prematures and 32.2 percent of the control mothers. In both groups, there was a social class gradient: the proportion of wives of salaried, commercial, and professional men working after the 30th week of pregnancy was 15.0 percent for mothers of prematures and 23.2 percent for control mothers, whereas for wives of unskilled manual workers, the corresponding proportions were 35.3 and 33.0 percent. Average hours of work per week were 39 hours for both groups. Work involving appreciable physical effort occurred in 24.5 percent of the mothers of prematures and in 23.8 percent of the control mothers. Some form of domestic help, almost all of it unpaid help by husband and/or mothers, was received by 50.1 percent of the mothers of prematures and 47.0 percent of the control mothers.

Drillien[57] in Edinburgh compared premature births without complications and mature controls without complications. She found that, among the primiparas, 68 of 107, or 63.6 percent, of those who had premature infants were employed during pregnancy, as compared with 97 of 154, or 63.0 percent, of those producing mature infants. Employment for 6 months or more occurred in 31.8 percent of the mothers of prematures and 27.9 percent of the mothers of mature infants. Among the multiparas, 14.3 percent of the mothers of prematures worked during pregnancy as compared with 13.8 percent of the mothers of mature infants; the proportions for those employed for 6 months or more were, respectively, 10.7 and 6.9 percent. Similar findings were obtained when all births, including those with complications, were studied.

Terris and Gold [17] studied 197 premature births to Negro ward patients with no known cause of prematurity. Each premature infant was matched with a mature birth to a Negro ward patient by sex and birth order of the infant, and by age and marital status of the mother. Of the mothers of premature infants, 23.1 percent were employed during pregnancy and 8.7 percent worked in the last trimester; the corresponding percentages for the control mothers were 25.6 and 5.6 percent.

Although there have been relatively few studies on this question, the available evidence makes it appear unlikely that employment during pregnancy is associated with prematurity.

Maternal Height and Weight

Baird and Illsley,[58] using the mother's height as an index of her nutrition during the years of growth, showed a relationship between height and prematurity among married primiparas in Aberdeen between 1949 and 1952. The prematurity rate for single births was 11.7 percent in women under 61 inches, 7.8 percent in women 61 to 63 inches in height, and 5.6 percent in women 64 inches and over. Only 10 percent of the women in socioeconomic class I (professional occupations) fell into the shortest group, as compared with 31 percent of the women in class V (unskilled workers); 49 percent of class I women were in the tallest group as compared with only 18 percent of class V women. The relation of height to prematurity held true in each social class, while the relation of social class to prematurity also appeared to hold true for each height category.

Martin[56] obtained somewhat less clear-cut results in his study of 1,097 primiparous mothers of premature infants in Greater London and Southeast Lancashire and an equal number of controls matched by age and social class. Fewer tall women were found in the premature group than in the control group for each social class; the magnitude of the difference varied, however. It was very considerable in the professional, salaried, and commercial class (48.4 vs. 66.0 percent) and the nonmanual wage-earning class (38.6 vs. 56.1 percent), but comparatively slight in the skilled manual workers (37.1 vs. 41.5 percent), semiskilled manual workers (33.3 vs. 43.0 percent), and unskilled manual workers (36.7 vs. 41.4 percent).

In the study by Drillien[57] in Edinburgh, the conclusions were drawn on the basis of multiple regression analysis that, first, liability to premature delivery depends on the social class a woman was brought up in, and not at all on her stature, and, second, liability to produce a small baby at term is greater for short than for tall women, but, among women of any given height, those low in the social scale have a greater risk than those of higher social origin.

Backman and Unnérus,[47] in reviewing a series of birth records collected from the Women's Clinics in Helsinki, found the mean height of the mothers of 530 mature infants to be 161.0 ± 0.3 cm., whereas the mean height for mothers of 174 premature infants was 160.1 ± 0.4 cm. The difference is not statistically significant.

Donnelly and his colleagues,[59] in a study of births at the hospitals associated with the three medical schools in North Carolina, replicated Baird's finding that height correlates directly with social class. They also demonstrated a relation of prematurity to maternal height for white mothers and for the higher social class of nonwhite mothers, but no such relationship was found for the lower social class of nonwhite mothers. The results of the study of Terris and Gold [17] of Negro ward births are consistent with the latter finding; no relation was found between maternal height and prematurity.

On the other hand, all reported studies show an inverse relation between maternal weight and prematurity. McKeown and Record [60] studied 450 women whose children were born during a single year in a county borough and found that the mean birth weight, standardized to remove the influence of maternal weight, varied as follows with maternal height:

Maternal height (in.)	*Standardized mean birth weight*
Under 62	7.14
62–63	7.40
64–65	7.25
66 and over	7.40

When the mean birth weight was standardized to remove the influence of maternal height, it varied more regularly with maternal weight:

Maternal weight (lb.)	*Standardized mean birth weight*
Under 110	6.80
110–129	7.18
130–149	7.55
150 and over	7.58

McKeown and Record concluded that birth weight is related to both height and weight of the mother, and that, of the two variables, weight has the greater influence.

Thomson and Billewicz[61] studied 4,215 Aberdeen primigravidas in three weight-for-height groups. The incidence of prematurity was 4.1 percent in 1,054 overweight women (those in the heaviest 25 percent of subjects at each height), 6.9 percent in 2,112 women of average weight, and 9.6 percent in 1,049 underweight women (those in the lightest 25 percent of subjects at each height).

Tompkins, Mitchell, and Wiehl[62] studied 1,570 births at the Philadelphia Lying-In Hospital between 1947 and 1953. Classifying mothers by immediate pregravid weight, they showed that the prematurity rate rose stepwise from 2.3 percent for women who were 25 percent or more overweight to 13.2 percent for women who were 15 percent or more underweight.

Backman and Unnérus[47] found the mean weight of the mothers of 530 mature infants to be 65.2 ± 0.4 kg., and the mean weight of the mothers of 174 premature infants to be 61.2 ± 0.7 kg.; the difference was statistically significant.

Terris and Gold,[17] in their study of Negro ward births, found that 14.4 percent of mothers of premature infants had postpartum weights under 110 pounds, as compared with 3.1 percent of mothers of mature controls. The reported usual maternal weight before pregnancy was under 110 pounds in 22.4 percent of the mothers of prematures and 5.2 percent of the control mothers. The ratio of usual maternal weight before pregnancy to maternal height was under 1.7 lb./in. in 13.5 percent of the mothers of prematures and in 2.1 percent of the control mothers. All these differences are significant at the .001 level.

Birth Interval

The fact that prematurity rates are greatest in very young women of high parity suggests that short intervals between births may be a factor in prematurity. Douglas[52] investigated this question in his study of 13,257 single legitimate births of known weight occurring in Great Britain during a single week in March 1946. He found that, regardless of the mother's age, the incidence of prematurity is significantly higher for births which occur within 2 years after a previous delivery. At the other extreme, the prematurity rate increases somewhat for birth intervals over 6 years.

In making his calculations, Douglas failed to take into account the shorter length of gestation of premature births. The hazard involved is well illustrated by data from the retrospective study by Terris and Gold.[17] They found that the interval between the present birth and the previous live or stillbirth was a year or less in 19.4 percent of mothers of prematures and in 10.4 percent of mothers of mature controls. When, however the interval was calculated on the basis of the expected date of confinement of the present birth, it was found to be a year or less in 13.8 percent of mothers of premature infants and in 10.1 percent of the control mothers; the difference is not significant.

Prenatal Care

It has long been accepted that prematurity is associated with lack of prenatal care. Eastman[63] found that at the Johns Hopkins Hospital for the period 1926 to 1945, the prematurity rate for spontaneous single births was 26.4 percent for mothers receiving no prenatal care, 23.7 percent for those with one or two visits, and 7.8 percent for mothers with three or more prenatal visits. He pointed out, however, that these differences may not be due to prenatal care per se, but rather to differences in habits of living between those who obtain prenatal care and those who do not.

Similar results have been reported by other investigators. Oppenheimer,[64] for example, found that in the District of Columbia in 1958, the prematurity rate was 22.7 percent for those who did not have prenatal care and 10.4 percent for those who did. The New York City study by Pakter and her colleagues[65] showed a prematurity rate of 27.9 percent for unmarried mothers who had no prenatal care and 14.1 percent for those who received prenatal care before the third trimester. The corresponding rates for married mothers were 21.6 percent and 7.7 percent. The authors concluded that "early prenatal care pays dividends in lower rates of premature births for all mothers."

This conclusion is open to question. As Eastman pointed out, the association of prematurity with lack of prenatal care may be a secondary association, since the failure to obtain prenatal care may merely reflect other habits of living which are responsible for prematurity. It is well established that prematurity is associated with low socioeconomic status and the age of parity of the mother;[1] these are factors which may also influence the receipt of prenatal care. In order to determine the difference in prematurity rates of mothers with and without prenatal care, the two groups should be compara-

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ble with regard to other factors which influence the occurrence of prematurity.

Another difficulty arises from the shortened length of gestation of premature births. Mothers of premature infants may not receive prenatal care because the early birth of the infant intervenes. Shwartz and Vineyard [66] of the District of Columbia took account of this difficulty by using a modified life table approach adapted to the span of gestation. They found no association of prenatal care and prematurity for women with complications of pregnancy. There was also no association for women without complications who delivered prior to gestation week 36. A significant association of prenatal care and prematurity was found only in women with uncomplicated pregnancies who delivered in gestation week 36 and thereafter; this association was independent of maternal age, parity, race, and income level.

Other studies have failed to show any relation of prematurity to prenatal care. Martin,[56] for example, compared 1,097 primiparous mothers of premature infants in Greater London and Southeast Lancashire with an equal number of controls matched by age and social class. Attendance for prenatal care compared as follows:

TRIMESTER IN WHICH PRENATAL CARE BEGAN

Trimester	*Prematures*	*Controls*
1	68.0 percent	68.8 percent
2	22.3	23.8
3	2.8	1.7
None	2.0	1.0
Unknown	4.9	4.7
Total	100.0	100.0

The average week at which prenatal care began was 12.8 weeks for the mothers of prematures and 12.3 weeks for the control mothers.

Drillien[57] in Edinburgh found that for mothers without complications, as well as for all mothers, there was no difference in prenatal care. For example, the proportion of mothers with no complications who attended a prenatal clinic in the first 16 weeks of pregnancy was 83.2 percent for primiparas with premature births, 84.3 percent for primiparas with mature births, 85.5 percent for multiparas with premature births, and 89.7 percent for multiparas with mature births. The proportions in these four groups that were judged to have received adequate prenatal care, taking into account length and regularity of attendance and other relevant details, were, respectively, 91.4, 96.7, 92.7, and 91.3 percent. Of the mothers with no complications, there was 1 of the 162 mothers of premature births who had had no prenatal care, as compared with none of the 269 mothers of mature births. There was an additional mother of a premature birth who put off attendance until the 33d week or more, as compared with four mothers of mature births who did so.

Terris and Gold,[17] who studied 197 premature Negro ward births with no known cause of prematurity, and an equal number of mature controls matched by sex and birth order of the infant, and age and marital status of the mother, found no differences between mothers of premature infants and mature controls in the week of pregnancy at which the first visit was made. Since the number of prenatal visits is limited by the duration of gestation, an expected number of prenatal visits (based on the recommended schedule of visits and the length of gestation) was calculated for each mother. It was found that the ratio of observed to expected visits was 43.3 percent for the mothers of premature infants and 46.0 percent for the mothers of mature controls. This failure to find a relationship between prematurity and prenatal care must be interpreted with caution, however, since the study was done at a voluntary hospital with very few walk-in deliveries. In the municipal hospitals of New York City, a substantial proportion of deliveries occurs to women with no prenatal care. The sample used in this study essentially excludes mothers with no prenatal care, and it may be that a similar investigation conducted in a municipal hospital would give different results. The finding that the mothers of premature infants had the same timing and amount of prenatal care as a comparable group of control mothers does, however, cast additional doubt on the presumed role of prenatal care in preventing prematurity.

Outcome of Previous Pregnancies

The study of United States births in early 1950[67] showed that the prematurity rate is related to the outcome of previous pregnancies. Women with a history of previous fetal death have a prematurity rate of 10.0 percent, as compared with 6.2 percent in women without such a history. The difference occurs at all degrees of parity and is greater for whites than for nonwhites. Furthermore, there is a marked tendency for women with fetal deaths in previous pregnancies to have children with very low birth weight.

In 1932, Murphy and Bowman[68] of the University of Pennsylvania found that 238, or 8.2 percent, of 2,876 consecutive live births were premature. Of 44 multiparous mothers of premature infants, 8, or 18.2 percent, had had previous premature births. They concluded that the incidence of premature births appears to be greater in women who have been previously delivered prematurely, than in the population at large.

Gardiner and Yerushalmy[69] studied 2,337 births in Buffalo City Hospital of order two and over. The mothers of 2,116 full-term infants had 7,950 previous pregnancies recorded at the hospital, of which 89.6 percent resulted in full-term births, 1.8 percent in premature births, and 8.6 percent in miscarriages and abortions. The mothers of 221 premature births had 965 previous pregnancies, of which 80.5 percent resulted in full-term births, 5.1 percent in premature births, and 14.4 percent in miscarriages and abortions.

Conway,[70] at University College Hospital in London, compared 133 multiparous mothers of prematures with 207 multiparous mothers of mature infants. It was found that 21.0 percent of the mothers of prematures had previous premature infants, as compared with 6.8 percent of the mothers of mature infants. The difference is significant at the 1 percent level. There was no difference in the proportion having previous stillbirths (11.3 percent of mothers of prematures and 12.6 percent of mothers of mature infants).

Karn, Lang-Brown, MacKenzie, and Penrose[71] used the records of University College Hospital in London to obtain material concerning repeated pregnancies of 1,714 mothers. Only surviving infants, defined as those who reached the age of 28 days after birth, were included. Three kinds of sib pairs were studied: first versus second born (891 pairs), second versus third born (314 pairs), and first versus third born (228 pairs). It was found that where the earlier-born sib was premature by birth weight, 14.1 percent of later-born sibs were also premature. Where the earlier-born sib was normal in weight, only 3.2 percent of later-born sibs were premature.

Terris and Gold,[17] in their study of 197 premature Negro ward births with no known cause of prematurity, and an equal number of mature controls matched by sex and birth order of the infant and age and marital status of the mother, found a very marked difference in the history of previous premature births in the 144 pairs of multiparas. Of the mothers of premature infants, 53.8 percent gave a history of previous premature births, and 21.7 percent had more than one previous premature infant. In contrast, only 20.3 percent of the mothers of mature controls gave such a history, and only 4.9 percent had more than one previous premature infant. Consistent with these findings is the maternal history of previous neonatal deaths. There were 14 mothers of premature infants who gave such a history, and 4 of these mothers had more than one neonatal death. Only 2 mothers of mature controls gave a history of previous neonatal deaths, and there was none with more than one such death. There were 14 mothers of premature infants who gave a history of previous stillbirths as compared with 6 mothers of mature controls. On the other hand, there were no differences between the two groups in the number of previous miscarriages reported.

Two recent studies have compared low weight term infants and those with premature delivery. Ounsted [72] at the Radcliffe Infirmary in Oxford used three series of mothers: (1) 225 unselected pregnant women interviewed in the prenatal clinic before the 20th week of gestation; (2) 90 women from the same obstetric departments whose infants' birth weight was more than two standard deviations below the mean for the duration of pregnancy calculated from the L.M.P. (Only those whose date of L.M.P. was definitely known, whose periods were normally regular, and in whom the height of the fundus at first examination was equivalent to the stated period of gestation, were included); and (3) 100 women from the same obstetric departments whose infants' birth weight was 5-½ pounds or less but lay within one standard deviation from the mean for the duration of pregnancy. This group was considered to represent those in whom the low birth weight was wholly or largely determined by the brevity of their gestation period.

The data were collected by a standardized interview using a standardized form. Multiple pregnancies were excluded from the study. Series 1 included four infants with birth weights below two standard deviations from the mean, and seven infants with gestations under 37 weeks. All of the infants in series 2 weighed 5-½ pounds or less at birth, and only one had a gestation period under 37 weeks. The series 3 infants all weighed 5-½ pounds or less at birth; the data on gestation period are not given, but presumably most if not all of them had a gestation period under 37 weeks. The proportion of live born siblings with a birth weight of 5-½ pounds or less was 12.2 percent of 221 siblings of series 1(mature) infants, 44.4 percent of 99 siblings of series 2 (premature by weight) infants, and 9.4 percent of 127 siblings of series 3 (premature by gestation) infants. Of the series 2 siblings, 18.8 percent had a birth weight below two standard deviations from the mean for the duration of pregnancy, as compared with 5.9 percent for the series 1 siblings.

Ounsted states that the length of gestation of live born siblings in series 1 and 2 is closely similar, indicating that the series 2 mothers show no tendency to brief pregnancies. The data, however, do not support this statement. There were 10 of 221, or 4.5 percent, of series 1 siblings who had gestation periods under 37 weeks, as compared with 16 of 101, or 15.8 percent, of series 2 siblings. The difference is significant ($P < .001$).

Ounsted describes the population from which her series were drawn as prosperous, well fed, and well housed. It should be noted also that the data on siblings were obtained by interview; it is not stated whether records were used to obtain their birth weight and length of gestation.

North[72] was unable to confirm Ounsted's results. He studied a number of subsamples of the approximately 18,700 infants delivered at the Strong Memorial Hospital in Rochester, New York, during a 7-year period. About half of the total deliveries were ward patients, and about 25 percent were nonwhite. All data were taken from hospital records. The proportion of previous pregnancies resulting in low birth weight infants was higher for mothers of infants premature both by weight and gestation than for mothers of infants premature by weight alone. In turn, the proportion was higher for the latter group of mothers than for the mothers of "average" infants. Both differences are significant at the .001 level. The data follow:

	Gestational age (weeks)	*Birth weight (grams)*	*Number studied*	*Percent of mothers' previous pregnancies resulting in low birth weight infants*
Small for dates	37–44	2,000–2,500	680	13 percent (203/1,500)
Very small for dates	37–44	1,000–2,000	82	9 percent (15/175)
Preterm	28–36	2,000–2,500	318	19 percent (144/771)
Small preterm	28–36	1,000–2,000	52	31 percent (46/148)
"Average"	37–44	3,000–3,500	1,978	6 percent (229/3,846)

The available evidence leaves no doubt that prematurity is a repetitive phenomenon. The data are not sufficient at this time to judge the relation of the two subgroups—term infants of low birth weight and infants with short gestation periods—to this recidivism.

Definition of Prematurity

In my review[1] in 1963, I remarked on the definition of prematurity (a birth weight of 2,500 grams or less) that "It is quite clear that we are not dealing with a single entity—namely, births due to premature labor, but rather with a mixture of two groups of infants: (1) those who are truly premature, and (2) those who are full term but have low birth weight. If, as may well be the case, the factors responsible for premature labor are different from those causing low birth weight in full-term infants, it will be difficult to demonstrate etiological relationships, since the group of so-called study cases will actually be a mixture of study cases and controls."

This was hardly an original statement. The W.H.O. Expert Committee on Maternal and Child Health, in its third report [74] in 1961, stated: "In view of the convincing evidence showing that many of the babies included within the limits of the definition, in certain areas, are not born prematurely, the Committee recommends that the concept of 'prematurity' in the definition should give way to that of 'low birth weight'."

In 1951, McKeown and Gibson[75] had found in a study of 16,749 single births in Birmingham during 1947 that 63 percent of infants premature by weight had gestations of 37 or more weeks. The study was limited, however, to infants delivered after the end of the 28th week.

Yerushalmy, van den Berg, Erhardt, and Jacobziner[76] reported that in New York City in the 3-year period 1957–1959, 54 percent of 23,619 single white live births premature by weight, and 42 percent of 12,230 single Negro live births premature by weight, had gestations of 37 or more weeks. The data are based on deliveries at 20 or more weeks' gestation. These workers have recommended classification of premature births into five groups, which have the following neonatal mortality rates:

Group	*Birth weight* (*grams*)	*Gestation* (*weeks*)	*Neonatal deaths per 1,000 live births*	
			White	*Negro*
I	1,500 or less	All gest.	656.2	613.2
II	1,501–2,500	<37	93.7	59.1
III	1,501–2,500	37 or more	30.3	22.1
IV	2,501 or more	<37	13.7	9.4
V	2,501 or more	37 or more	4.7	6.2

It should be noted that, excluding the special group of very small infants (1,500 grams or less) who have an extremely high neonatal mortality, the highest neonatal mortality rates occur in infants who are premature both by weight and gestation. The next highest mortality occurs in infants who are premature by weight but not by gestation; their rates are more than double those of infants who are premature by gestation but not by weight. In comparison with whites, Negro infants in all prematurity groups have lower neonatal mortality rates, while mature Negro infants have higher mortality rates.

Alternative classifications of premature infants by birth weight and gestational age have been offered, but appear to be less useful for epidemiologic studies than the groups listed above.[77] Future studies will have to use such classification, both by weight and gestation, if they are to make significant contributions to our understanding of the epidemiology of prematurity.

Conclusions

We are now able to make more definitive statements about the role of certain presumed factors in the etiology of prematurity than was possible 5 years ago.[1] Cigarette smoking during pregnancy is clearly associated with prematurity by weight but not by gestation; however, its relation to perinatal mortality is still uncertain. Asymptomatic bacteriuria is definitely not associated with prematurity. The available evidence does not appear to give firm support to a relationship of prematurity to maternal relative heart volume, work during pregnancy, birth interval, and prenatal care. Maternal weight is more clearly associated with prematurity than maternal height. Mothers of prematures tend to have repetitive premature births, but it is not clear whether and to what extent this holds true both for prematurity by weight and prematurity by gestation.

No work has been done during the past 5 years on the role of maternal nutrition in prematurity. In view of the higher rates in low economic groups and in poor countries, as well as the relationship to maternal weight, it would appear urgent to reopen this issue. The previous studies were contradictory and poorly designed. As I stated in my earlier review,[1] "There is a great need for new and more sophisticated studies which will learn from the experience and errors of previous work."

Finally, all new research on the epidemiology of prematurity will have to be based on study groups classified both by weight and gestation. Some of the current conclusions may have to be modified as a result of such investigations.

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PANEL DISCUSSION

RESPONSE
by

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I would like to respond to Dr. Terris' presentation in two ways: first, with a few comments about some of the specific problems he discussed and, secondly, with some general opinions about the implications of our current state of knowledge.

Cigarette Smoking

We have at least three points to clarify about the relationship between cigarette smoking and infant birth weight.

First, do "cigarette light" infants have any increased risk of death and disability? One technical point can be mentioned here. Infants born of multiple pregnancies have different risks of death from single born infants. As a result, the pattern of relationships between infant deaths and such maternal characteristics as age and parity is entirely different when the study population includes only single live born infants than when it includes all live born infants. We will continue to have difficulty in pinpointing consistent results until all investigators use the same numerators and denominators to describe death rates.

The second point to clarify is whether or not women who smoke have more fetal wastage. If they do, is it because cigarette smoking causes fetal loss, or is cigarette smoking a characteristic of women who lose their products of conception for other reasons? Another technical point can be brought out here. Fetal wastage can only be adequately and properly studied prospectively in well-defined cohorts of women. Detailed epidemiological study is needed to see if fetal wastage and/or infant mortality is higher in specific groups of smoking women.

The third point is simply: what is the biological process by which cigarette smoking reduces infant birth weight? This is more than the academic point it may at first seem to be. If, as has recently been suggested,[1] smokers

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have light weight babies because they do not eat enough, then smokers who are given additional food during pregnancy might have heavier infants.

If, on the other hand, cigarette smoking causes vasoconstriction which reduces placental perfusion and fetal nutrition, then vasodilator drugs might be an effective preventive measure. It is worth reemphasizing that cigarette smoking does not shorten pregnancy. This fact is of major biological importance in plans to counteract or prevent the effects of cigarette smoking.

Maternal Bacteriuria

The most obvious lesson from the series of studies on maternal bacteriuria is acceptance of the technical difficulty in design and analysis of studies of pregnancy outcome. There are two major reasons for this difficulty: first, that women enter (that is, register into) and leave (that is, deliver out of) studies at different stages of their pregnancies; and, second, that pregnancy outcome is determined by innumerable related and interdependent factors which need, as Dr. Terris said, sophisticated design and analysis to separate direct and indirect relationships.

Positive findings of higher prematurity rates in small studies may be explained by a very simple bias. The prematurity rate of any group of patients changes with the dates used as cut off points for the study.

A group of patients followed from prenatal registration until everyone has delivered will have a lower prematurity rate than will be calculated for the same women between stated dates of registration and delivery.[2] As a result of this bias, the rate of prematurity for selected (e.g. bacteriuric) women attending a prenatal clinic within a defined period of time may be spuriously higher than the rate in the source population.

The results of one matched pair analysis of bacteriuric women and controls are shown in Table 1. Each bacteriuric woman was matched with a nonbacteriuric control on each of seven factors known to be related directly or indirectly to infant birth weight—namely, age, parity, physique, smoking habits, infants' sex, race, and stage of pregnancy at time of prenatal registration.

Two points: (1) bacteriuric women do not have lighter weight babies and do not have shorter pregnancies; and (2) there is very little difference

TABLE 1.—*Matched pair study*

	Women with bacteriuria	*Matched controls*
Number of infants	369	369
Average birth weight (in grams)	3125.46	3093.38
Average difference in birth weight (in grams)	32.08	
Average gestation (in days)	268.43	267.12
Average difference in gestation (in days)	1.31	

between the average birth weights and average lengths of gestation of women with bacteriuria and their matched controls. Matching with seven specified characteristics predicted birth weights of the control infants within an average of 32 grams. Without matching, the average infant of a bacteriuric patient was 70 grams heavier than that of a nonbacteriuric patient.[3] This ability to predict birth weight relatively precisely should have some implication in practice.

Maternal Physique

Concerning the relationship of infant birth weight to maternal physique, we have shown by regression analysis[4] that preconception weight relative to each woman's height is the most important single known factor in predicting the birth weights of the infants of women attending our prenatal clinic. Our patients were put into seven groups from the lightest to the heaviest for any given height. Holding other factors constant, there was an average increase of 70 grams in infant birth weight for each maternal physique group. We have also looked at the ratio of infant birth weight in grams divided by duration of gestation in days. (Described as "the growth rate" by Dr. Gruenwald.) This ratio is consistently lower in underweight women of all parities, all ages, all smoking habits, whatever the sex of their infants. The ratio is reduced more by differences in maternal physiques than by any other single factor studied.

Table 2 shows the ratio of $\frac{\text{birth weight in grams}}{\text{gestation in days}}$ for single live born male infants of 7,635 Negro women. The data are classified by physique, smoking habits during pregnancy, and number of previous pregnancies.

TABLE 2.—*Mental Physique*[*]

Number of previous pregnancies	UNDERWEIGHT		AVERAGE WEIGHT		ABOVE AVERAGE WEIGHT	
	Non-smoker	*Smoker*	*Non-smoker*	*Smoker*	*Non-smoker*	*Smoker*
1	11.4	10.8	11.5	11.0	11.8	10.8
2	11.3	11.3	11.6	11.4	12.4	12.0
3	11.2	10.9	12.3	11.5	12.2	12.3
4	11.8	11.1	12.1	11.5	11.4	12.3
5	10.4	11.7	12.4	11.3	12.4	12.4
6	10.6	11.7	11.9	11.7	13.3	10.8

[*] Standardized for height

Baird[5] has suggested that natural weight gain during pregnancy does not compensate for poor physique at the time of conception. We now have to see to what extent supplemental feeding can improve the infants of underweight mothers. Further, we have to focus on the development of ideal physique before conception occurs.

Prenatal Care

In analyzing our data, we have tried to develop a type of life-table analysis to show the effect of prenatal care given to similar women identified at different stages of pregnancy. It is important to note that all women in this study receive some prenatal care. The amount of care cannot be shown to change group outcomes in terms of infant birth weight or length of gestation. Two major points have to be remembered. Prenatal care is essentially a screening test for a limited number of pathological conditions—e.g., toxemia, Rh incompatibility, multiple pregnancy, abnormal presentation, and hemorrhagic complications. The results of this screening process on measurements of pregnancy outcome depend upon the relative frequencies of these conditions in populations studied. If they are very common and if they are prevented, the group, as a whole, will show an overall effect of prenatal care. If, however, they are rare, changing the outcome in the few women who get them will have no effect on group measurements.

The second point is that little has been added to prenatal care since the days when the complications listed were much more common. It is time we considered the components of prenatal care over and above this (necessary) screening process. We should ask how the components of prenatal care should and do vary from community to community and from program to program according to the relative needs of different groups of women.

Types of Babies

We are making such rapid progress in the clinical recognition of different types of premature babies,[6,7,8] that it is time we looked separately for causes of "light early" and "light for their dates" babies. There is no longer any excuse for the use of exactly the same definition of prematurity in planning care for Negro and white babies. Whatever the cause, there is ample evidence in this country that Negro babies have shorter gestations and appear to grow more rapidly on a unit scale of gestation.[9]

Service programs have to be so constituted that they will serve the specific needs of the different types of premature babies. Further, prenatal care has to be tailored with an eye to the relative risks of different types of premature babies. We should be able to say: What type of prematurity is associated with toxemia? What are its consequences? What type of prematurity is associated with inadequate weight gain? What are its consequences? The competing risks will decide whether weight control of supplemental feeding is the order of the day.

—Now, a few overall suggestions.

Research

The best way to learn more about prematurity now is to design well-controlled clinical trials of prevention of specific types of prematurity. While sophistication in design is needed to pinpoint single factor effects in this interrelated variable situation, this should not be confused with other kinds of sophistication. Goldberger showed very clearly that food could prevent pellagra long before the more specific cause of pellagra was identified. We can follow his example and see whether or not food prevents at least one kind of prematurity in a certain group of women, and we can do this without pinpointing the specific nutrients involved. To me, this latter is a second or third order experiment. We have to accept the fact, I believe, that we can learn very little more from observational studies and have to start experimental studies.

A great deal of effort must be put into the identification of direct from indirect associations with infant birth weight so that we can take steps to interrupt or manage direct effects. For example, does toxemia actually cause prematurity, or is the same kind of a girl likely to get toxemia and bear a premature infant?

We know that the same kind of women have fibroids, hypertension,[10] and poor reproductive efficiency. Which is the direct effect on pregnancy outcome?

Practice

It would seem that there are several potentially useful applications of our current knowledge. First, each prenatal population should be described according to its component groups of high risk women. These groups should be limited to those for whom quantitative risks can be calculated. Secondly, prenatal care should be designed either as separate programs for each of the predetermined risk groups, or overall programs should be flexible enough to give each risk group its own modifications. Outcome measurements should be calculated separately for each predefined risk group within a program so that an overall weighted measurement can be developed and compared from one program to the next.

One of the best ways to change practice rapidly would be to hold a series of inquiries about the "cause" of every premature baby born, the sort of inquiry that was held for every maternal death and which I feel did so much to remind us of the precautions we have to take to avoid maternal death.

Finally, we have to develop much better and much more careful measurements of important indicators of maternal and infant progress during pregnancy.

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RESPONSE

by

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The Children's Bureau recently prepared some estimates to illustrate the impact of maternal morbidity more generally on birth weight and on perinatal and infant survival. At a time when our national objective is to enhance maternal health and to reduce infant mortality, these estimates give us a needed indication of what might be accomplished by reducing the incidence of maternal morbidity, or complications of pregnancy, through an extended and effective program of maternity and infant care.

In this study, focused on relationships of maternal morbidity, low birth weight (2,500 grams or less), and survival, the patient records of 209,828 maternity patients (single births in 1963) in 143 accredited hospitals were abstracted according to a standardized procedure. The hospitals were limited to those with 500 or more beds and which had an established "perinatal mortality committee." The hospitals were rather widely distributed across the country; nevertheless, they speak for themselves and not for hospitals generally which care for maternity patients in the United States.

Twenty-four percent of the mothers in this study had one or more complications of pregnancy. The six most frequent complications reported on patient records were preeclampsia, anemia (hypochromic, microcytic), cord around neck, premature rupture of membranes, cephalo-pelvic disproportion, and abruptio placenta (accidental antepartum hemorrhage). Other complications frequently mentioned included Rh sensitization, placenta previa, and cystitis.*

Some of these conditions are largely preventable, such as preeclampsia, anemia, cystitis. In the case of cystitis, routine microscopic examination of urine on asymptomatic pregnant women expedites diagnosis, and, with good obstetrical management, prematurity associated with cystitis can be prevented. Cephalo-pelvic disproportion is preventable in many cases: (1) through prevention of rickets by giving young girl children vitamin D; (2) by prevention of oversize babies; (3) by watching the mother's weight; (4) by control of mother's fluid retention with diuretics; (5) by control of diabetes if the mother is a diabetic, etc. When not preventable, obstetric management, (cesarean section at term) can be both lifesaving and preventive of brain damage secondary to trauma of attempted labor with hopes of vaginal delivery.

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* Source of data for the study: Foundation for Medical Research, Perinatal Study, Major Maternal Complications of Pregnancy in Accordance with Certain Socio-Economic Categories. Assisted by Maternal and Child Health Program Research Grant H-87, Children's Bureau, U.S. Department of Health, Education, and Welfare.

Cord around the neck is not a preventable condition. However, fetal death (or brain damage from anoxia) from this cause can be prevented by continuous observation of pregnant women during active labor. Obstetric intervention at first sign of fetal distress is lifesaving (and prevents mental retardation in a live born infant by prevention of anoxia).

Premature rupture of membrane is not ordinarily preventable. In the case of twin pregnancy, bed rest in the last trimester helps. Closure of patent cervical os with sutures is another preventive measure. Furthermore, good obstetric management can often prevent infection of the amniotic sack and secondary infection of the baby in utero. Infection in the newborn frequently results in death, and in central nervous system damage when the baby lives (secondary to meningitis, which is common in newborns).

While abruptio placenta and placenta previa are viewed as fortuitous, good obstetric management can save the baby's life and prevent brain damage from anoxia.

In this study, the group with complications, i.e., one out of four mothers, had an incidence of low birth weight among their infants of 13.8 percent, or more than double that of infants born to mothers free of complications (Table 1). The data include low birth weight in live and stillborn.

By the same token, the perinatal death rate for infants born to mothers with complications was nearly five times that for infants of mothers free of complications (56.2 vs. 11.7 per 1,000 total births, live and still). The fatality rate was higher for infants of mothers with complications whether the infants were of low birth weight (286.4 per 1,000 with maternal complications vs. 131.6 per 1,000 without complications) or not (19.5 per 1,000 with maternal complications vs. 4.3 per 1,000 without complications).

The greatly increased incidence of low birth weight, and greatly increased death rates for infants in all weight categories stemming from impaired maternal health, strongly suggests that prevention of complications in pregnancy, whenever possible, and more effective management of complications that cannot be prevented, will greatly reduce infant losses in the perinatal period. It is also to be expected that benefits to the infant through strengthening of maternal health will extend beyond the neonatal period. Low birth weight infants who survive the first month are known to experience higher postneonatal risks than the postneonatal infant who had a birth weight of 2,501 grams or more. In fact, this differential may persist through the preschool years and possibly longer. A major health benefit for the mother in

TABLE 1.—*Percent of total births (live and still) with low birth weight (2,500 grams or less), perinatal mortality rate, according to whether complications of pregnancy were reported: perinatal study, 143 accredited hospitals of 500 or more births per year, 1963*

Item	*Total*	COMPLICATIONS	
		None reported	*One or more*
Total births (live and still)			
Number	209,828	159,495	50,333
Percent	100.0	76.0	24.0
Percent of births with low birth weight	7.8	5.9	13.8
Ratio	100	76	177
Perinatal deaths per 1,000 births[1]	22.4	11.7	56.2
Ratio	100	52	251
"Low birth weight" (2,500 grams or less)	197.3	131.6	286.4
Ratio	100	67	145
2,501 grams or more	7.7	4.3	19.5
Ratio	100	56	253

[1] Fetal deaths, plus deaths in hospital in newborn period per 1,000 total births (live and still).

successful prevention or management of complications is her greater freedom from accumulation of episodes of reproductive failure during the childbearing years, with their forebodings of disasters to come.

Were we able today to prevent two out of three complications of pregnancy, or prevent their ill effects through optimum management, it is estimated that: (1) the total number of perinatal losses associated with complications would be cut by one-third, while the total perinatal deaths (with and without complications) would be reduced by 23.5 percent (in terms of the 1965 figures, this would mean a drop of from 127,278 perinatal deaths to 97,365); and (2) neonatal deaths would decrease by about 24 percent, and the total infant death rate would drop 17 percent. In terms of 1965 events, this would mean a reduction in infant mortality from 24.7 per 1,000 live births to 20.5, and in numbers of deaths from 92,866 to 77,256.

And, of course, additional infants will survive their first year when added emphasis is placed on intensive care of the low weight infant and on control measures protecting infant well-being as such—for example, improved procedures at delivery and immediately after, and prevention of deaths from infection and accidents.

Some Dimensions of the Maternity Population

We are today looking ahead to the extension of comprehensive maternity and infant care for families who are now without adequate services. This extension can be expected to be national in coverage over a period of years. In this connection, we need to remind ourselves of the growth of the childbearing population and of the newborn population. According to estimates provided by the Bureau of the Census, women of childbearing age (15–44 years) numbered 39.5 million in 1966 and will number 42.3 million in 1970 46.9 million in 1975, and 51.9 million in 1980—an overall increase of 31.3 percent from 1966.

The percent increases in the newborn population will be larger, with 3.6 million births in 1966 increasing to 5.3 million in 1980, a 43 percent increase.

Year	*Births (in millions)*	*Percent increase from 1966*
1966	3.6	.....
1970	4.1	14
1975	4.7	27
1980	5.3	43

All of these estimates are from the series of Census projections which conformed most closely to actual events in 1965 and 1966 (Series C).

Medical Manpower in Expanding Programs

These projected increases in the childbearing and infant populations bear directly on the need for physicians in general practice and in obstetrics-gynecology and pediatrics. The supply of physicians is extremely uneven among states of different per capita income levels, ranging in 1966 from 17 percent above the U.S. average ratio (135.4 physicians per 100,000 population) in high per capita income states, to 28 percent below the average in low per capita income states. The gaps are still wider between metropolitan and nonmetropolitan counties. In metropolitan counties, the physician ratio was 28 percent above the U.S. average, while in adjacent and isolated nonmetropolitan counties, it fell below the average by 52 percent and 42 percent, respectively (Table 2).

A Yardstick for Assessing Reduction in Infant Mortality

Given the general goal of reducing infant mortality, which is inherent in programs to enhance maternal health, specific objectives can be set up to serve as an aid in judging progress. Thus, if we take as a specific objective the reduction of the U.S. infant death rate from 24.7 per 1,000 in 1965 to 17.8 per 1,000 (10 percent of U.S. counties have already attained this level or lower), and a date is set for accomplishing this objective, we can judge annually and roughly whether the trend is on course or otherwise. If, in fact, this particular goal is set to be reached before 1975, the annual percent reduction in the national rate should be about 3.6 percent (2.12 percent for white infants and 8.78 percent for nonwhite). This same pace would need to be maintained in the metropolitan counties. In nonmetropolitan counties, the pace of reduction would need to be increased to about 3 percent for white infants and to 10–11 percent per annum for nonwhite infants. These differences in needed rate of reduction indicate that concentrated efforts must be directed not only

TABLE 2.—*Physician ratios to specified population by per capita income groups of states (1963–65), and by county groups (1960): United States, July 1966*

Physician ratios[1]	PER CAPITA INCOME GROUPS OF STATES (1963–65)			
	United States (51)	*High* (17)	*Middle* (17)	*Low* (17)
Physicians (total) per 100,000 population (total)	135.4	158.6	122.5	97.9
Index	100	117	90	72
Obstetricians and gynecologists per 10,000 live births	43.4	52.6	38.1	29.8
Index	100	121	88	69
Pediatricians per 100,000 children under 15 years	24.7	30.7	20.4	17.0
Index	100	124	83	69
	COUNTY GROUPS[2]			
	United States	*Metropolitan*	*Adjacent*	*Isolated*
Physicians (total) per 100,000 total population	135.4	172.8	64.4	78.8
Index	100	128	48	58
Obstetricians and gynecologists per 10,000 live births	43.4	56.6	19.3	16.6
Index	100	130	44	38
Pediatricians per 100,000 children under 15 years	24.7	33.9	8.1	9.4
Index	100	137	33	38

[1] Excludes physicians in military installations, those overseas, and June graduates.

[2] Metropolitan counties are those with a city of 50,000 or more (1960); adjacent, those contiguous to metropolitan; isolated, those noncontiguous to metropolitan and without an urban place as large as 2,500 population (1960).

to many large urban centers where "excess" mortality is most extensive, but also to areas where the highest infant death rates prevail in the adjacent and isolated counties (Table 3).

To summarize: 1. Greatly expanded programs of comprehensive maternity and infant care can be expected to measurably reduce the incidence of maternal complications and their effects on proportions of newborns with low birth weight and upon fatalities in the prenatal period. 2. New programs must take account of probable growth in the size of the newborn population and the maternity population, as well as the implications for the medical manpower supply.

TABLE 3.—*Estimated annual percent reduction in infant mortality rate, from 1965, by color group; assuming the U.S. county group rates in 1974 are 17.8 per 1,000 live births or less*[1]*: United States and county groups.*

County group	*Total*	*White*	*Nonwhite*
	PERCENT		
United States	–3.60	–2.12	–8.78
Greater Metropolitan	–3.15	–1.60	–7.92
Lesser Metropolitan	–3.17	–2.00	–8.11
Adjacent	–3.77	–2.48	–9.80
Isolated			
Semirural	–4.77	–2.95	–10.42
Rural	–5.31	–3.15	–10.81

[1] Ten percent of United States counties, 1961–65, had infant mortality rates at 17.8 per 1,000 lives births, or lower rates.

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RESPONSE

by

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While Dr. Terris recognizes at the end of his paper that the term "premature" is not synonymous with "low birth weight," it is unfortunate that in the body of his paper, the term "premature" is used for "low birth weight." It is not merely a question of semantics; it is known that a large proportion of low birth weight infants of 2,500 grams or less are born at term and that a not insignificant proportion of infants with birth weight of over 2,500 grams are born preterm. Not only the birth weight but also the length of gestation and, more specifically, the interrelation between these two or the rate of intrauterine growth are important in the study of the etiology of neonatal mortality and child health and development.[1,2] Therefore, the ambiguous term "prematurity" should be avoided and replaced by more precise terms. If information on length of gestation is not used, the term "low birth weight" rather than "premature" should be employed.

Dr. Terris makes it clear that the process of analyzing single factors in the study of etiology is not sufficiently rewarding. The risk of low birth weight is influenced by a large number of factors which are often interrelated. Indeed, the strength of certain factors might not be revealed except in populations representing extreme values of these factors. Consequently, conclusions derived from special population groups are subject to great limitation.

Dr. Terris criticizes a number of investigations because certain variables were not included in the matching of the study groups and the control groups. While this criticism is certainly justified, it must be kept in mind that it is only possible to match for a limited number of suspected factors, and it may never be possible to construct a control group matched for all pertinent factors.

The situation at present is that only a small number of factors have been definitely established as etiologically related to low birth weight or to short gestation. Perhaps one reason for the lack of knowledge in this area is that, in

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most investigations, the unit of study is the "prematurity" rate, and little attention is given to the prognosis of low birth weight infants according to the factors under study. Thus, in the previous discussions, emphasis was on the frequency of low birth weight according to a variety of factors, such as smoking, mother's height and weight, etc., and very little on whether these factors are associated with different outcomes of the low birth weight infants with respect to mortality, congenital anomalies, and mental retardation.

One paradoxical phenomenon which begins to emerge in our Child Health and Development Studies is that, when the frequency of low birth weight infants increases in association with a certain characteristic, the low birth weight infants who possess that characteristic experience a lower neonatal mortality rate compared to low birth weight infants who do not possess that characteristic. As an illustration, it has been shown that smoking mothers have a considerably higher frequency of low birth weight infants than nonsmoking mothers. This led Dr. Terris to conclude that cigarette smoking during pregnancy is definitely related to prematurity. However, most of the studies report the important observation that the perinatal mortality for infants of both groups of mothers is virtually the same. This paradoxical situation was explained by the findings of our extensive Child Health and Development Studies[3] as being due to the fact that a prognosis for survival of low birth weight infants of smoking mothers is much better than those of nonsmoking mothers (Table 1[*]). These data are based on some 8,000 white single live births. All the past smokers are excluded. It is seen that the neonatal mortality of low birth weight infants of smoking mothers is 108.8, which is much lower than that of the low birth weight infants of nonsmokers, which is 197.0. This phenomenon holds also for live born Negro infants.

TABLE 1.—*Neonatal mortality of infants with low birth weight by mother's smoking habits*

Rates per 1,000 live births
Child Health and Development Studies 1960–66

Birth weight (grams)	*Smoker*	*Nonsmoker*
≤2500	108.8	197.0
>2500	4.3	4.1
Total	11.0	10.2
#	3722	4229

The same paradoxical situation may be noted for other characteristics; for instance, height of the mother and weight of the mother. While it is true that the frequency of low birth weight infants is inversely related to these characteristics, the neonatal mortality rate is directly related to them.

Table 2 shows the neonatal mortality of infants of less than 2,500 grams for short mothers and for taller mothers. The neonatal mortality of low birth weight infants of the short mothers comes to 118.3 and increases gradually for taller mothers to 152.4 and finally to 184.6.

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[*] All the following tables relate to single white live born infants.

Table 3 gives the neonatal mortality for low birth weight infants by mother's weight. It is seen that the same relationship exists: that there is a low neonatal mortality of 108.7 among low birth weight infants of the mothers with the lowest weight. It rises to 189.2 for the mothers with the highest weight. It is seen, therefore, that the relationship of any characteristic with the frequency of low birth weight tells only a small part of the story because the relationship is, indeed, a very complex one.

TABLE 2.—*Neonatal mortality of infants with low birth weight by mother's height*

Rates per 1,000 live births
Child Health and Devedopment Studies 1960–66

Birth weight (grams)	*Mother's height in inches*			
	<62	62–65	>65	Total
≤2500	118.3	152.4	184.6	157.7
>2500	6.3	2.9	4.7	3.9
Total	14.0	9.8	10.9	10.7
#	1355	5835	3755	10,945

TABLE 3.—*Neonatal mortality of infants with low birth weight by mother's weight*

Rates per 1,000 live births
Child Health and Development Studies 1960–66

Birth weight (grams)	*Mother's weight in lbs.*			
	<112	112–159	160+	Total
≤2500	108.7	156.0	189.2	148.4
>2500	3.3	4.0	3.4	3.8
Total	13.7	10.1	9.0	10.4
#	1023	8097	1218	10,338

Dr. Terris points out that prematurity is a repetitive phenomenon but states that "it is not clear whether and to what extent this holds true both for prematurity by weight and prematurity by gestation." In a number of studies, Yerushalmy[4] showed that there exists a remarkable specificity to this repetitive phenomenon. Thus, as shown in Figure 1, a woman who lost a previous birth through fetal death of less than 20 weeks' gestation had an increasing risk of losing a subsequent pregnancy through fetal death of less than 20 weeks, but no increase for other forms of pregnancy loss. This specificity is noted also for the fetal death of more than 20 weeks, neonatal mortality, and postneonatal mortality. Even more remarkable is the specificity of the products of conception of different combinations of birth weight and

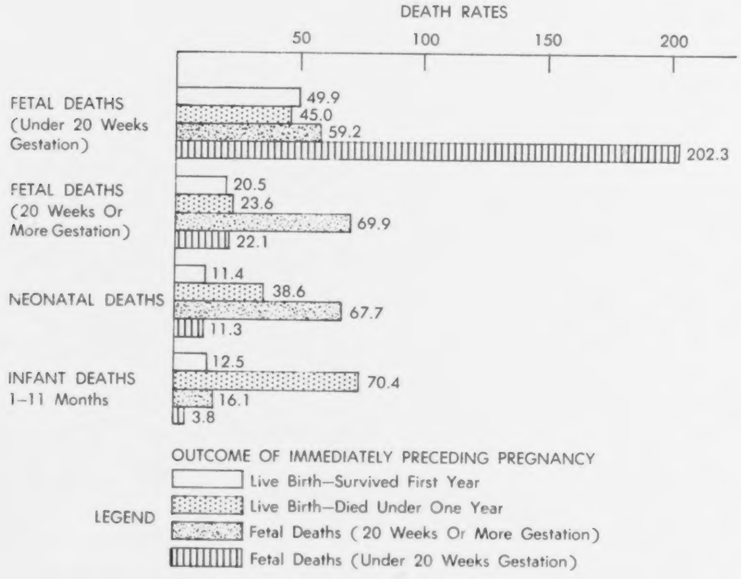

FIGURE 1.—Rates of fetal, neonatal and postneonatal mortality in birth order 2 and 3 according to outcome of immediately preceding pregnancy

gestation (Figure 2).[5] For example, a woman who had in her immediately preceding pregnancy an infant with a gestational age of less than 37 weeks and a birth weight of less than 2,500 grams has a high risk of giving birth to an infant of the same type—that is, preterm and of low birth weight—but

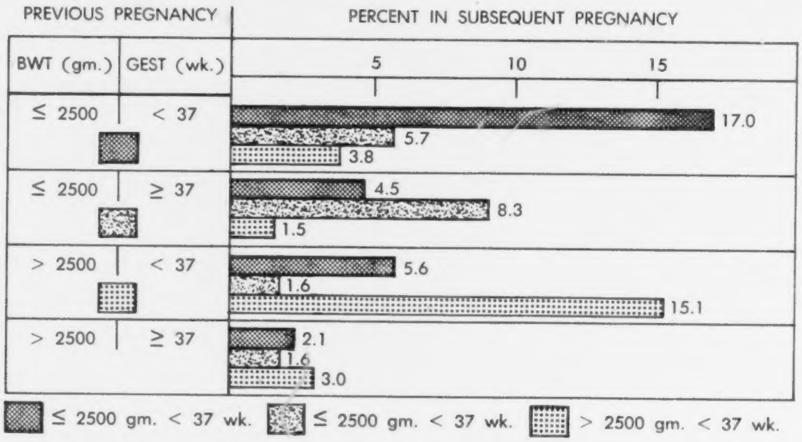

FIGURE 2.—Specificity for birth weight and gestational age of repetitive character of premature birth

little or no increase is noted for the other groups. The same repetitive characteristic is noted for the other birth weight gestation groups.

In the context of this meeting, the main interest in "low birth weight" and preterm children relates to their contribution to the problem of mental retardation. The study of the sequelae of "low birth weight" is as difficult, or even more so, as is the study of etiological factors. A review of the literature shows that the developmental prognosis of low birth weight infants is still far from established. The problems related to the selection of the study population and the control group, as well as those related to adequate follow-up, have been evaluated recently by Abramowitz in a review covering a great number of studies conducted in several countries.[6]

Most studies agree that children of low birth weight have a higher risk of severe congenital anomalies which interfere with "normal" physical growth and mental development. It is difficult to estimate the extent of this severely handicapped group, as no uniform standards are used to define both low birth weight and severe anomaly.

More recently, the phenomenon of congenital anomalies began to be investigated not by birth weight alone, but also by the interaction of birth weight and length of gestation. We in the Child Health and Development Studies used the five categories as shown in Table 4. Group I are the very tiny infants with birth weight of less than 1,500 grams of all gestations; both group II and group III include children with birth weights between 1,500 and 2,500 grams, but group II children have a gestation of less than 37 weeks, and group III children of 37 weeks or more. Group IV is composed of infants who have a birth weight of over 2,500 grams but have a short gestation of less than 37 weeks, and group V are infants who are "mature" by both weight and gestation; that is, they have a birth weight of over 2,500 grams and a duration of gestation of 37 weeks or more.

TABLE 4.—*Classification by birth weight and gestation*

Child Health and Development Studies 1960–66

Group	*Birth weight* (grams)	*Gestation* (weeks)
I	$\leq$1500	all
II	1501–2500	<37
III	1501–2500	37+
IV	>2500	<37
V	>2500	37+

A study of the frequencies of severe congenital anomalies in these five groups produced interesting findings, as seen in Table 5. First, the highest frequency of severe congenital anomalies was found for the very tiny infants of less than 1,500 grams at birth, of whom more than a quarter of those who survived the first year of life had one or more severe congenital anomalies. However, the only other group showing a high rate of severe congenital anomalies is group III with children with birth weights between 1,500 and

2,500 grams and 37 or more weeks' gestation. These are the children who suffered perhaps from intrauterine maldevelopment or intrauterine growth retardation. It is striking that children weighing 1,500 to 2,500 grams at birth with a gestation of less than 37 weeks have no greater risk of a severe congenital anomaly than children who were "mature" at birth according to criteria of both birth weight and gestation.

TABLE 5.—*Percent of children with severe congenital anomalies among those surviving the first year of life*

Child Health and Development Studies 1960–66

Group	*Birth weight* (grams)	*Gestation* (weeks)	*Percent of children with severe congenital anomalies*
I	≤1500	all	28.5
II	1501–2500	<37	2.0
III	1501–2500	37+	7.0
IV	>2500	<37	2.7
V	>2500	37+	2.1
Total			2.3

As the low birth weight children compose only a small proportion of the total population of children, they contribute to only 11 percent of the total number of children with severe congenital anomalies.

No consensus exists on the mental adequacy of low birth weight children who do not suffer a severe congenital defect. Two studies may be mentioned here which give opposite results. A study with an effective followup is that of McDonald.[7] This study relates to surviving children with birth weights of 4 lbs. or less (1,815 grams or less), who were born in 1951–53 and admitted to 19 premature baby units in different parts of Great Britain. Of this group, 98.3 percent, or about 1,000 children, were available for study at the age of 6 to 9 years. After exclusion of children with serious defects (cerebral palsy, blindness, deafness, and I.Q. below 50), McDonald found that the children's scores on the Stanford-Binet test were not different from those of the general population of the same age.

The Baltimore study of Wiener, Harper et al.[8,9] relates to about 400 children of 6 and 7 years of age who had birth weights of 2,500 grams or less (three-fourths of them were between 2,000 and 2,500 grams). After exclusion of children with I.Q. scores of less than 50 and of children with other gross anomalies, the investigators found statistically significant differences in I.Q. between the low birth weight children and their controls with birth weights of more than 2,500 grams (matched for race, sex, social class, and maternal child rearing practices).

The Child Health and Development Studies might later be able to contribute to a clarification of this issue. At present, in a physical and mental screening examination, the children of low birth weight and/or short gestation who reached the age of 5 years, given that they did not suffer a severe congenital anomaly, did not compare unfavorably with children of higher birth weight and gestation.

In summary, I believe that a critical review of the literature would show that the knowledge now available on the possible etiology of low birth weight and short gestation is insufficient to lead to impressive improvement of these problems. However, it appears that the search for the prevention of mental retardation may not necessarily be based on the prevention of low birth weight. The latter contributes to only a minor proportion of the problem of mental retardation. The data of our Child Health and Development Studies must, for the moment, be tentative. It is possible that when children enter school, the relationship of mental retardation to low birth weight and short gestation will be more pronounced. However, our current observation, which includes all survivors of very low birth weight of 1,500 grams and less and other low birth weight children who have attained their fifth birthday, shows that the low birth weight children who did not suffer from a severe congenital anomaly were as mentally alert as those born full term and with normal birth weight.

The study of etiological factors of low birth weight and of short gestation is, of course, for its own sake, very important. Perhaps we have to be careful not to be too preoccupied with this problem in connection with the problem of mental retardation. It indeed might have the negative result of diverting efforts to study factors which are more directly related to this very important problem.

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GENERAL DISCUSSION

Dr. LaVeck: The Session is now open for general discussion.

Dr. Gruenwald: I agree with Dr. van den Berg that one should be careful with terminology. As you know, the World Health Organization, in 1961, suggested that the term "prematurity," when based on birth weight, should be replaced with "infant of low birth weight." Dr. van den Berg has used it in that sense, and I have also. On the other hand, the Committee on Fetus and Newborn of the American Academy of Pediatrics recognized that this term is also being used in a different sense, as Dr. Terris has done, and that is for "small-for-date babies." Therefore, in the report which appeared in the June 1967 issue of *Pediatrics,* the Academy of Pediatrics suggested that terms not be used. Instead, groups of infants should be defined by the range of birth weights—for instance, 1,000 to 2,500 grams—and that no specific name be used for them. The Academy also suggested that the infants be divided into preterm, full-term, and post-term groups and, further, to judge them on the basis of percentile for week of gestation, as "small," "adequate," and "large" for dates. This is an excellent suggestion. My only point of disagreement with Drs. Yerushalmy and van den Berg's classification is that the cutoff point at 1,500 grams makes it somewhat difficult to compare statistics. It does not help us to differentiate the baby above and below 1,000 grams, and this difference, which is considerable, is one that most people like to make.

I would like to substantiate what some of you have alluded to; namely, that not truly premature babies contribute to infants of low birth weight data. Of all the infants of low birth weight among 5,000 consecutive deliveries at the Sinai Hospital of Baltimore, 29 percent had a birth weight below mean minus two standard deviations for their week of gestation and are, therefore, severely growth retarded. (Lubchenco accepts the tenth percentile which includes more than three times as many cases.) Forty-five percent had a gestational age of full 37 weeks or more. Thus, even in this population, which was a mixed private and ward, mixed Caucasian and Negro population, depending on the criteria used, anywhere from one-third to one-half of the total low birth weight population were not premature. For groups with an unfavorable environment in which the low birth weight rate is higher, it is likely that these proportions are even higher. Therefore, it is important to realize that growth retarded fetuses are not just a few freak occurrences, but are quite common.

Figure 1 shows some information that is indirectly related to the problem we are discussing. It comes from data of the British Perinatal Mortality survey in 1958. (The solid line with the open circles shows the rate of perinatal death by gestational age.) As you know, the rates drop precipitously down to about 38 weeks. This has led many people to the conclusion that low birth

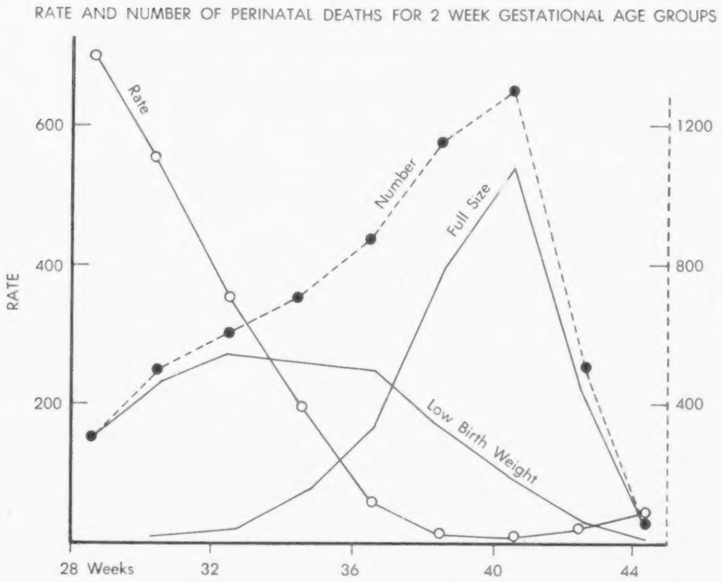

FIGURE 1.—Based on article by P. Guenwald, "Stillbirth and Neonatal Death," to be included in a book edited by Butler et al and published by E. & S. Livingstone, Ltd., Edinburgh and London.

weight is one of the most, or the most, significant factor in perinatal mortality. However, if you look at the number of perinatal deaths in this same population which was nationwide (the dotted line with the solid circles), you find that the number of deaths is highest in the group with the lowest rate, because so many more babies are born in this group. The peak number of perinatal deaths is at term. This graph also shows perinatal deaths broken down in terms of infants of low birth weight and full-size infants over 2,500 grams.

Though I do not wish to detract from the importance of studying low birth weight infants, it is important for us to realize that they really do not account for such an overwhelming share of mortality and, presumably, morbidity. While we should certainly do everything we can to prevent low birth weight, we should not forget the full-size infant. It seems that mortality and, presumably, morbidity are preventable to a greater extent in full-size infants than in those of low birth weight. The growth-retarded fetus does have a higher mortality than the full-grown fetus of the same gestational age. However, unless growth retardation is extreme, the mortality is certainly lower than that of preterm infants. This accounts for the fact which Dr. van den Berg has so well demonstrated—that the groups which have many of the moderately growth-retarded infants have a relatively low mortality among the infants of low birth weight.

DR. LAVECK: Dr. van den Berg, would you like to comment on Dr. Gruenwald's concern with the 1,500 gram cutoff point?

Dr. van den Berg: Yes, I, too, believe that it is a difficult group. Since we included all the children who were live born, some who have considerably less birth weight than 1,000 grams were also included. Almost all of them died.

Dr. Wasserman: Obviously, studies must be designed to deal with a limited number of variables, but, when we conceptualize our thoughts, I am concerned about the need to relate these isolated findings to a much broader philosophy. For example, from some of the statements I've heard this morning, I think I could make a case for the advantages of smoking. If mothers who smoke have smaller babies, and morbidity and mortality are not increased, perhaps these babies will be easier to be delivered.

When we turn to the problem of weight, which seems to be best related to outcome, here again I am somewhat concerned. From the point of view of a pediatrician, one of our most dismal failures in practice is to influence the weight of children and adolescents. Thus, I am concerned that we might come up with some information which would indicate that control of weight is important and yet be completely unable to do anything about it. This is much like the smoking situation: smoking is bad for you, but relatively few people have stopped. From the point of view of philosophy, we must think of nutrition in a much broader sense. We must be concerned with the effects of nutrition not only on the mother during the very short period of gestation, but also on the young girl as she grows and enters into motherhood.

Dr. Jacobson: One of the conclusions that Dr. Terris made—that prenatal care had no influence on the outcome of pregnancy, at least in terms of infant size and in relation to the amount of prenatal care that the mother received—is of concern to me. This goes back to a question about current critieria in regard to what constitutes prenatal care. (I am sorry Dr. Bishop is not here today because this is part of his talk tomorrow.) As I understand it, our categories, or our description, of adequate prenatal care were a makeshift device that was set up when maternal mortality committees were first started in order to give some means for assigning blame for a bad outcome. That if a patient had registered at such and such a time and had made so many visits, that this meant the physician had discharged his responsibility. To what degree are the reports of the amount of prenatal care a patient receives based solely on the number of visits she makes to her physician, and to what degree are they based on what happens to her when she sees him? Isn't it like the problem in education? Simple attendance in a school does not guarantee an education if what is involved is simply roll-taking or quizzing. Something positive has to happen.

Dr. Terris: It is important to remember that the data which link prenatal care to prematurity or low birth weight are all based on attendance counts. The intention was only to show that the women with little or no prenatal care also had the highest prematurity rate. Very little has been done in terms of the kinds of care. In essence, what we have said is: a more careful look at the data reveals what I believe is true—you are dealing with an artifact; the artifact is simply that the "walk-ins" are people who might have had prenatal

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care if they had not had a premature delivery. This is probably the main factor involved in this simple count.

If what I have said is true, and from my review of the literature I feel that it is, then we have to start all over again. The basic idea that prenatal care was related to prematurity came from the attendance counts, and now it has become a question of a much more careful analysis of the relationship of different kinds of prenatal care. I believe Dr. Henderson made this point.

The issue which this raises is this: that an attempt is being made on a national scale, through the maternity and infant care program,[*] to improve prenatal care—to give better prenatal care than the individuals we are concerned with actually get in the overcrowded clinics in county and municipal hospitals. Yet it must be stated that no one has dared to look at this in a serious way. To my knowledge, there is no serious experimental study of the effect of the M & I program on the outcome of pregnancy. This kind of timidity, with regard to examining what we are doing, is to be deprecated. We should move ahead very rapidly along the lines of Yerushalmy and van den Berg—of trying to evaluate prenatal care and the elements of prenatal care and what they really do.

Dr. Gold: As we analyze and evaluate our efforts in the M & I programs, I believe we will begin to identify the specific high risk groups of patients. We are already beginning to develop, for certain groups, specific programs of care, including antepartum, postpartum, and rehabilitative in the interconceptional period. This, in turn, will be related to further analysis of outcome of pregnancy.

At the present time, there is unquestionable evidence of the gross effects of the type of care given under the M & I programs. In some areas, such as in Chicago, Baltimore, and New York City, salutary effects can be seen with regard to the gross analysis of outcome of pregnancy as determined by prematurity or low birth weight infants and by reduction in perinatal loss. More specifically, in the New York City M & I program, the low birth weight incidence for a super high risk group of patients, involving almost 700 deliveries a year, was reduced from 21.9 percent in 1966 to 15.5 percent in 1967. In the same 2-year period, the total perinatal loss, namely, fetal deaths 28 weeks plus the early infant deaths under 1 week, was reduced from 80.3 percent in 1966 to 49.7 percent in 1967.

Dr. Henderson: I am sorry, Dr. Gold, but I have to raise the point that I believe Dr. Terris made and it slipped by. You are again describing observational studies, and I think you are in great danger of repeating Dr. Kass' pattern. I know these data for the M & I projects. The definition of high risk groups is so variable from one time to the other, and from one day to the next, that there is no denominator by which to calculate a true change. I am not aware of any experimental situation where women described adequately are put into categories of those who do, or do not, receive a specific item of care to see if that one item of care makes a difference. Until we do this, I cannot believe that any of the reported observations are not due either to change in the characteristics of the women who are being included in the studies or to some other variable.

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[*] Hereafter, may also be referred to as M & I.

In terms of the babies Dr. van den Berg describes, I had a medical student make a study of 1,500 children who had been examined in the Head Start program. First, the student collected their birth certificates. Then he divided these children, who had been physically examined at the age of 4 to 5 years, into percentiles, according to their height and weight. In other words, he classified these children according to their physical development between the ages of 4 and 5, and we specified a 4-month interval. Then he looked at the percentage of babies under 2,500 grams who had been born after a longer pregnancy. This preliminary study showed that the babies born early (the small early babies) who survived to the age of 4–5 were equally distributed in the top and bottom percentiles of height and weight. These infants grew normally, if they lived. But the babies who were small after a normal length of pregnancy were aggregated in the lowest percentiles. In other words, children who are small for their gestational age do not seem to grow; however, the ones who are only small seem to grow normally, if they survive.

Dr. Gellis: I wonder, Dr. Henderson, if this study separated out the congenital abnormalities in that latter group which was in the low percentile, because it seems to me that congenital anomalies are higher in that group.

Also, I agree that in viewing the incidence of mental retardation in low birth weight infants, compared with the incidence of mental retardation in full-term infants, one should eliminate the infants with major anomalies. But I am not certain which anomalies were excluded. For example, the presence of a major congenital abnormality of the heart doesn't necessarily mean there is impairment of intellectual capacity. I thought Dr. van den Berg said that, in viewing this situation, cerebral palsy was one of the conditions excluded, and I question why it was listed among major congenital anomalies, since there are so many different etiologies for cerebral palsy.

Dr. van den Berg: I agree that it is difficult to define severe congenital anomalies. We have the impression in our group that children who have any type of severe congenital anomaly also have mental problems. I will not say this is congenital, but it might be that these children have less opportunity to learn. It's a difficult problem. As far as cerebral palsy is concerned, in some it might have been caused by birth trauma. I do not want to say that this makes the premature group less important, although congenital anomalies are very important too, but it is a different group from what we call mental retardation in general. Small babies contribute a relatively large proportion of severe congenital anomalies, but, excluding this, their contribution to mental retardation is perhaps not that impressive.

Dr. Clifford: A number of years ago, we recognized the importance of the difference between a baby who is of low birth weight versus one who is mature, in studying the cases with so-called dismaturity or placental dysfunction. Since that time, it has been well recognized. One of the earliest to really identify these distinctions was Dr. Lubchenco with her chart of intrauterine growth. Then we had the classification of the five groups of Yerushalmy.

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Now we hear that Dr. Gruenwald has a classification and takes some issue with the Yerushalmy grouping. The Academy of Pediatrics has come out with a different grouping. Then, if I read between the lines correctly, Dr. Hunt suggested that a more accurate method of defining this group for statistical reasons is needed. Certainly this Conference should not end without coming to some positive conclusion as to how these babies should be described and how the resultant data should be used from now on in our different analyses. If we use three or four different methods of defining them, we will be just as bad off as we were with prematurity—and maybe worse.

Dr. Gruenwald: I have no system of my own. I personally would be in favor of the suggestion of the Committee on Fetus and Newborn of the Academy of Pediatrics. The trouble with Lubchenco's data is that, perhaps because Denver is a mile-high city, the birth weights above term are a little lower than in most of the United States. There are other standards available which would obviate that. However, particularly at the lower end, it has been pointed out that in the low birth weight group, this is not of very great importance.

As far as malformations are concerned, there is a very basic difference between the infant who has a severe malformation and one who is deprived in utero. These malformed infants apparently have a reduced growth potential. They are not deprived and there are several lines of evidence to suggest that. Thus, they are a different group. And whenever we study the effects upon fetal growth of maternal or environmental factors, or any others, it is quite important to eliminate the malformed infants for this reason. The literature on the experimental production of malformations in animals shows that, practically without exception, wherever birth weights of these animals are given, they are always below par as compared with normals of that same species. Therefore, it is important to remember that this is an entirely different group and, for basic biological reasons, should be treated separately.

Dr. Hunt: The desirable procedure is to study the situation on the basis of continuous variables, such as the growth and development studies of older individuals. There is a classical body of literature on this that would set a very good example. The Chinese, for instance, count those weeks in utero, so the child when born already has recorded a certain age in his life. What we might aim for is the development of a methodology to take observations which can be translated into growth statistics. This would require procedures that, I believe, are not presently available. It would be very helpful if observations on the growth of the infant could be made at regular intervals during the period of gestation. We also need to take into consideration that growth statistics, which are not based on longitudinal observations of the same individuals, are really cross sectional sets of data for varying individuals. A rather different impression is obtained of the variability at a given age if the study is based on sequential observations at regular intervals on the same individuals.

Dr. Benirschke: Both Drs. Terris and van den Berg have directed our attention to what I consider a very important group numerically—namely, those women with recidivism. I should like to ask if they would categorize for us, concerning women with recidivism: (a) what, numerically, they contribute to this problem, and (b) whether they segregate cleanly into recidivism leading to prematurity or to low birth weight babies, and if there are specific gestational characteristics that can be identified?

Dr. van den Berg: When we look at the various characteristics that we have been discussing, we find different proportions of increase in the different groups. For example, Table 1 below, which gives the proportion of children in each of the groups by mother's height, shows that the increase is highest in group III, the children of low birth weight and more than 37 weeks' gestation. There is an increase as well in the other groups. This is important, since the increase is mainly in the small women; when they become larger, the difference is very small.

Table 2 shows the proportion of children in each of the groups by the mother's weight. Here again, there is an increase in the five groups, but the increase is mainly in group III, the children with low birth weight and relatively long gestation.

This kind of differential increase is also seen in relation to other characteristics.

Table 1.—*Percent distribution of live born infants in five birth weight-gestation groups by mother's height*

Child Health and Development Studies 1960–66

Group	*Birth weight* (grams)	*Gestation* (weeks)	MOTHER'S HEIGHT IN INCHES <60	60–61	62–63	64–65	>65	*Total*
I	≤1500	all	1.0	.5	.4	.6	.5	.5
II	1501–2500	<37	3.8	2.2	1.8	2.1	1.6	1.9
III	1501–2500	37+	5.6	3.2	2.5	1.8	1.4	2.0
IV	>2500	<37	4.5	2.2	3.5	3.9	3.5	3.5
V	>2500	37+	85.1	91.9	91.8	91.6	93.1	92.0
	Total percent		100.0	100.0	100.0	100.0	100.0	100.0
	Number		288	1067	2620	3215	3755	10945

Table 2.—*Percent distribution of live born infants in five birth weight-gestation groups by mother's weight*

Child Health and Development Studies 1960–66

Group	*Birth weight* (grams)	*Gestation* (weeks)	MOTHER'S WEIGHT IN LBS. <112	112–159	160+	*Total*
I	≤1500	all	1.0	0.5	0.2	.5
II	1501–2500	<37	3.1	1.9	1.4	1.9
III	1501–2500	37+	5.8	1.7	1.4	2.1
IV	>2500	<37	3.1	3.4	3.5	3.4
V	>2500	37+	87.0	92.5	93.5	92.1
	Total percent		100.0	100.0	100.0	100.0
	Number		1023	8097	1218	10.338

Dr. Stone: I am trying to decide how confused I can be, especially in relation to all the terms we've been using—low birth weight, growth retarded, preemies, preterm, post-term, etc. Recently, in the *Journal of Obstetrics and Gynecology*, Dr. Jan Schneider suggested that since we like to use easy words, instead of preemies we should use "lowbies." It's not a bad idea. Since "low birth weight infants" is too long a phrase for Americans to say, perhaps we'll say lowbies from now on.

In addition to not knowing what infants we're talking about, I find that perhaps we're limiting ourselves to a very specific area of mental retardation. The statisticians, who are our conscience, can always stop you at any meeting and ask, "What were your controls?" Then the whole meeting is over. If we limit discussion to specifics, say to a small group of mental retardates, then we do need very specific studies that will tell us that *this* particular problem causes *this* degree of mental retardation, and we can or cannot do something about it. I would rather take a much more general view.

Another aspect that disturbs me is that unless we can have a control and show what it is we did, the biostatistician and epidemiologist will not accept improved results even if they should result.

Dr. Jacobson: I would like to second Dr. Clifford's plea that we come to some agreement at this session. This relates to Dr. Stone's problem concerning how to measure what we do, because we are entering the day of the collection of national statistics and census tract statistics. What happens when you try to combine data from different places when the ground rules do not agree at the beginning?

Dr. Gold: Since the tenor of the general discussion seems to point so obviously to the need for the development of a set of criteria and a redefinition of an accepted nomenclature in the area we are discussing, I would like to take the prerogative of Chairman of the Conference and suggest that the individuals who addressed themselves to this question be appointed as an ad hoc committee to do this. I would like to nominate to this committee Drs. Clifford, Gruenwald, van den Berg, and Henderson.

Dr. Gellis: I wonder if Dr. Gruenwald isn't simplifying the problem a little too much by stating that the low birth weight infant with a major anomaly should be eliminated from consideration. And is it necessarily true that all infants with a major abnormality fall into low birth weight groups? I believe there is a recent paper describing a study in which infants with a major abnormality of the heart fell into normal birth weights or even higher; thus, a sweeping statement should not be made for all major abnormalities.

Dr. Gruenwald: I am sorry if I gave that impression. Severely malformed infants have a high incidence of low birth weight for their gestational age. I would suggest, therefore, that studies which deal with fetal growth should eliminate them.

Dr. Clifford: I would like to add to what Dr. Gruenwald has said, and to again show the usefulness of considering the birth weight and gestational age. In a recent study, I concentrated on the babies under 1,000 grams in 14,000 deliveries. When these infants were divided into perinatal pregnancy wastage categories, it was very striking to find that there was a great differ-

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ence between those babies who died in utero and those who died shortly after delivery. In this particular group, the babies who had congenital malformations, some with Cornelia de Lang and other types of syndromes, and the babies who had erythroblastosis and died in utero and the babies who had placental insufficiency, half of them being placentas that were grossly infarcted and the other half being grossly small in size (very tiny placentas for the gestational age), these three, on the Lubchenco chart, were greatly below the 3 percentile. On the other hand, the group of babies who died after birth, for such causes as those associated with infection, incompetent cervix, abruptio placentae, were right within the expected weight for their age. This beautifully differentiates the two different groups of babies. Instead of bunching all of these together, we will study congenital malformations as a group. They will show up and, if we have the right classification for studying them individually, we will concentrate on one group after the other and avoid any mixing up of our statistics.

DR. GELLIS: I am very sympathetic with Dr. Stone's viewpoint. But isn't it obvious that unless we have exact controls and know precisely what we are doing, we can tremendously delude ourselves. Though I sometimes have difficulty understanding what the statisticians are saying, I feel it is very important that we carefully work out exact controls for anything we are manipulating; otherwise, 10 years from now, we will be right back where we are today.

DR. TERRIS: I would like to speak as an epidemiologist, not as a statistician; there is an important difference. The epidemiologist is a person who is concerned with disease in human population groups and who uses statistics to study disease in these terms. The clinician is interested in the effectiveness of a therapeutic agent—and he also uses statistics. One advantage the epidemiologist has is that some knowledge of statistics is included in his training, and I would say that most epidemiologists will have to defer to the statisticians in terms of a genuinely thorough knowledge of the field.

The point I want to make is that my paper is actually a very sorry collection of poorly designed studies—not in terms of fancy statistical methods but in terms of rather simple rules of scientific evidence. In regard to comparing a case group and a control group, knowing that social class influences prematurity or low birth weight, and then not making a determination as to whether a difference exists in social class between the two groups—this is not a statistical question but one of science, of scientific evidence. Obviously, if there is another factor that would influence the results, it is important to determine if that factor is responsible for the difference rather than the asymptomatic bacteriuria, or whatever else is being studied. What I'm aguing for, then, are relatively simple principles of scientific methodology.

I sympathize with the problem of the clinician who has to do the best he can with the knowledge that's available. One has to operate in terms of what is now known. On the other hand, if anything has come out of the discussion in this Session, it is that the available knowledge is weak. We are only beginning to move in the direction of separating out the different groups from the all-inclusive category of "permaturity." We are only beginning to apply a very careful scientific analysis to our data.

The plea I would make is that while I sympathize fully with the desire to develop a programmatic approach in the area of prematurity and low birth weight and its possible results, the state of our knowledge is such that we cannot be satisfied. I would like to see much more money and effort going into serious research—research which will have to be team research, with the clinicians and the epidemiologists and the statisticians working together.

Dr. J. D. Thompson: I agree with Dr. Terris that it is important for us not to make sweeping generalizations regarding clinical impressions which are not properly controlled. However, I suggest that a similar danger exists in making sweeping generalizations concerning sophisticated epidemiologic data that are difficult to interpret. The following thoughts, hopefully, will support what I say.

Dr. Terris is not able to prove that a relationship exists between the incidence of low birth weight infants and the interval between pregnancy. I believe the obstetricians in this room, particularly those who are primarily concerned with an indigent population, have repeatedly seen women whose reproductive experience began in their early teens. One pregnancy followed another in rapid succession, with no opportunity between pregnancies for nutritional and emotional reserves to be repleted. Gradually, as parity increased, the birth weight of the infants went down rather than up as it usually does in the general population. We have also studied this problem in patients in whom the age and the previous history of premature births were controlled; we found a decided difference in the incidence of low birth weight infants and the interval between pregnancies.

The question of work in pregnancy is a very difficult and important one to study. Here, I would like to tell you a little about the John A. Andrew Hospital which is a part of the Tuskegee Institute. This hospital serves indigent Negro expectant mothers in a five-county, entirely rural section of the State. The premature birth rate in that hospital goes up twice a year—once in the spring and again in the fall. In the spring, many of the families go out in the hot fields and chop cotton; in the fall, they go back out there and pick it again. These families depend on the cotton crop for their livelihood, and everybody participates in the work, including expectant mothers. If a pregnant woman is not feeling well, then she stays home—but she works just as hard, because she has to take care of all the other children, and she has to cook for the people working in the fields. Now that's work! And, for someone who has low reserves to begin with, this may very well have a deleterious effect on the outcome of pregnancy.

A few comments about antepartum care. There is a possibility that someone might interpret our remarks as suggesting that antepartum care is of no benefit. That is a possible sweeping generalization from what has been said. It is important for us to emphasize that antepartum care was designed around the turn of the century to accomplish an entirely different purpose: to reduce the high maternal mortality and morbidity rate. It is entirely possible

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that the M & I projects that are presently funded for indigent patients throughout this country are justified, simply on the basis of their further improvement in the maternal mortality rate. But, if antepartum care is to accomplish a different goal, then it must be redesigned. Probably, we will have to start talking, not just about antepartum care, but about total reproductive care, and even consider such very "wild things" as the possibility that an expectant mother may need to be seen every week in the first trimester of pregnancy. If she makes it through that critical period, then perhaps she can be seen every 2 months, as long as she has no complications, until her labor begins. I agree that there is very little you can do to prevent a low birth weight infant when the expectant mother presents herself for antepartum care in the second trimester of pregnancy.

Then, of course, there is the question about bacteriuria. It's dangerous to make sweeping generalizations about that also. Most people seem to agree, Dr. Terris, that asymptomatic bacteriuria is an important relationship and, of course, patients with asymptomatic bacteriuria more often develop urinary tract infections. In addition, there is a possibility that, because of the relationship between asymptomatic bacteriuria and reduced urine osmolality, the incedence of toxemia is increased in this group of patients.

Dr. Terris: Many issues have been raised. Let us consider asymptomatic bacteriuria. Is it a sweeping generalization to say that 20 studies are done; the first one reports a relationship between asymptomatic bacteriuria and prematurity or low birth weight babies; it gets support from a defective study—and 18 other studies of different kinds of sophistication, ranging from the most to the least sophisticated, fail to show the relationship. I feel that when we realize we are expending our time and energy in pursuing a fruitless clue, then the book should be closed. It would have been quite dreadful if the work had not been done and we had all continued to believe we were going to solve the prematurity problem or the low birth weight problem through dealing with the problem of asymptomatic bacteriuria.

In regard to work during pregnancy, the only sweeping generalization we can make here is that there is no good evidence to date of a relationship. We do not say that there may not be a relationship; it simply hasn't been shown. Most of the studies seem to indicate that the evidence is fairly weak. The same is true for birth interval. It may well be, and there is reason to believe, that birth interval may be a factor. But the evidence so far doesn't tell us this. I feel it's proper to state that we will worry about his problem on the possibility that it is a factor, but let's not take the position that it is a factor until we have the evidence.

I want to return to the question of control programs. It seems we should have the courage to study what we're doing and not go on as we have before. I see no reason, for example, why an M & I program couldn't do a very simple study. You could randomize patients and assign one to the M & I program and the other to the ordinary clinic. If this were done very carefully, the differences that occur under the M & I program might be revealed. What may come to light is that receiving maternity care through an M & I program makes no difference at all. But you might learn that it has very important effects. Then you would be in a position to say that we have good evidence that our M & I program does an effective job in this particular area. I don't know of any M & I program that has done this kind of study. Shouldn't we move in the direction of testing out our procedures?

Dr. J. D. Thompson: Dr. Terris, I would like to present to you a hypothetical sort of experiment, not designed necessarily to understand whether or not an M & I program has been of benefit, but perhaps to test antepartum care. Suppose you had 1,000 women who presented themselves for antepartum care in the first trimester of pregnancy, and you examined these women at the time of their first antepartum clinic visit—complete history and physical examination and certain of the basic screening laboratory tests. On the basis of these three steps, you would probably have a group of women who had complications of pregnancy or had a previous reproduction history that clearly indicated that they should be followed closely throughout the remainder of the pregnancy. Offhand, let's say this amounts to 33 percent of that group. On the other hand, the remainder of the women, as far as you can tell, have no problems. Would you be willing to send half of these patients home with the instruction that if they have any difficulty in the subsequent months of their pregnancy to report back to your hospital or your program and you will take care of them? Then, the rest of them would receive the usual standard programs of antepartum care which have usually been based on what a private doctor does for his private patient in his private office. This, in my view, is ridiculous—to try to transfer that to a clinic setting, where you're dealing with indigent patients and young physicians in training. Let's say these patients receive the usual standard antepartum care. Would you be willing to have such a patient care study as that done? Is this not the way in which you test the efficiency, or the influence, that antepartum care will have on the outcome of pregnancy?

Dr. Terris: One of the problems here is the danger that whan we say the evidence is not very good that prenatal care affects low birth weight and prematurity, this will be misinterpreted to mean that prenatal care is not effective with regard to other areas. What I am dealing with is the issue of whether prenatal care has an effect on prematurity. The evidence, to date, is not very good that such a relationship exists. This doesn't mean that prenatal care isn't good in other ways. The only proposal I made was that, given an enriched program of prenatal care, such as in the M & I program, one ought to see whether that enrichment really adds something with regard to both mothers and infants—and this can be done without running into certain ethical problems which you raise.

Dr. J. D. Thompson: I agree with you, Dr. Terris; it is dreadful that we do not have information about whether antepartum care is good. Not only that, but, hopefully, the degree to which it will affect favorably the outcome of pregnancy. We have long since passed the time when we can answer many of these questions, because they should have been answered at the turn of the century when antepartum care was first instituted. We may be able to answer little particular questions about different aspects of antepartum care; specifically, a detailed design of patient care research. But, on the other hand, it is entirely possible for an M & I program to show, for example, an increase in perinatal mortality rates. It is entirely possible for it to show that, rather than a reduction. How are you going to control matters under these circumstances?

Dr. Terris: We could go into the details of methodology. Actually, it could be done quite simply. If you had 1,000 patients eligible for an M & I program and, using a table of random numbers, you assign half of them to the M & I program and the other half to the ordinary O.P.D., then you can see what happens to these patients. The chances are, and you have to analyze for this as I pointed out in my paper, they would sort themselves out equally with regard to the various characteristics that may influence outcome. Hopefully, then, the one item you've changed is the enriched program. At this point, you could say with a fair degree of certainty what the result of your enriched program was. This is a fairly simple research design. I believe it could be done and that it would prove very helpful. Otherwise, we're left with observational studies and all the problems related to them.

Dr. J. D. Thompson: I would like to suggest that one of the major problems with antepartum care now is that so much of what is being done is worthless. So, you run into the question of eliminating things to test the quality of those things you are doing.

Dr. Terris: I feel we could work out a good study together.

Dr. W. T. Tompkins: I would like to raise another point before the group, to make an admission, and to offer a very serious challenge. It is true that not only in the M & I projects are we lacking in a uniform method of statistical input sufficient to describe these patients at the beginning and throughout the course of pregnancy. Without such a mechanism, we have no possible hope of a retrieval mechanism which can contribute to the problems presently being discussed. This is one factor that this Conference must consider—to encourage such a procedure in all hospitals that are concerned with the outcome of pregnancy. Further, before this Conference is over, we must come to some decision as to a definition of adequate prenatal care. This is a very serious deficit.

A last point. There is a tendency here, which I hope will not be fostered unduly, of concern for high risk mothers and high risk infants. If we concern ourselves with only high risk patients, by default and neglect we are going to make the patient who is not high risk at any specified time a high risk at a later date. We are penalizing the patient who happens to be normal today by neglecting to give her the competence of care and concern that she needs. Unfortunately, in the M & I projects, too many have focused their attention on the high risk patient at the expense of the nonhigh risk patient. This Conference must concern itself with all patients, not just a selected few.

Dr. Jacobson: The discussion concerning whether or not prenatal care makes any difference boils down to: what is the difference between the care that produces results and the care which does not? Thus, it is the ingredients of the service—the input and not attendance, not numbers of reports—that matter.

Dr. Fuchs: In Denmark, where the ancillary care has a very high percent-

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age of people in the program, the trend is that in subsequent pregnancies the use of the service is declining. I suspect this is also true here in our population: that there is a group who attended ancillary care clinics in their first pregnancies and then dropped out. Probably, in many cases, these women had a normal term infant in the first pregnancy, and they failed to see that all the time they spent waiting in the clinics for 2 minutes with the doctor at each visit had anything to do with the outcome of their pregnancies. Therefore, in subsequent pregnancies, they came very late in their pregnancy, or they did not come at all. This is a highly select group because they had a normal outcome of the first pregnancy. If such a group were located and compared with controls who had the same outcome in their first pregnancy, but attended antenatal care in their second, we might find out what we are doing with the low risk groups to which Dr. Tompkins just referred.

Dr. LaVeck: We have discussed many issues, and probably have solved very few. But, since some of these issues will come up repeatedly throughout the Conference, we will have the opportunity to discuss them again.

The purpose of this meeting was to identify some of the broad problems with which we are going to be confronted during the remaining sessions of the Conference. In this respect, it has been successful. I wish to thank Dr. Terris, members of the panel, and all of the participants for their contributions.

Dr. Gold: This first Session has come to a provocatively successful conclusion.

SESSION II

Prevention of Obstetric Antecedents

Session Chairman: WINSLOW T. TOMPKINS, M.D.

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PREVENTION OF OBSTETRIC ANTECEDENTS

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The fate of a conceptus is not always predetermined at the time of conception. The individual genetic code has been established, but many intrauterine factors may influence the development of the fetus, while many environmental factors in extrauterine life may reduce or enhance the individual's potential. Moreover, the incidence of prematurity, cerebral palsy, mental retardation, congenital anomalies, and sensory defects, as well as the perinatal mortality rate, may be closely correlated with a number of antecedents of conception. If we are to fulfill one of our obligations as physicians, that of improving the quality of the human race and making the United States of America one of the safest places in the world in which to bear and raise children, these antecedents must be understood and, whenever and wherever possible, altered or controlled.

In an attempt to understand the importance of the various obstetric antecedents associated with prematurity and perinatal mortality and morbidity, let us think imaginatively how we might significantly reduce the high perinatal mortality and prematurity rate in a large metropolitan city which has a well defined area and a perinatal mortality rate above 30. We will find there are many antecedents which we cannot control in a human reproduction, but it behooves us to begin imaginative thinking as to how we may influence many important ones.

Responsible Parenthood

In 1963, a survey made at the University of North Carolina, indicated that 82 percent of patients in social groups III, IV, and V had unplanned and unwanted pregnancies, while in social groups I and II, only 15 percent of the patients had unplanned pregnancies.[1] There is every reason to believe that the incidence of unplanned pregnancies in the lower social groups in the Houston area is equal to or higher than this figure. Although additional studies concerning parental motivation during pregnancy are necessary, it is believed that the high incidence of unplanned and unwanted pregnancies

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among lower social groups is the major reason why the United States stands 15th in the world in its perinatal mortality rate (Tables 1 and 2).

TABLE 1.—*Incidence of and perinatal mortality rates for various obstetrical complications according to social class in white and nonwhite patients**

	Social class	*Incidence prematurity (%)*	*Perinatal mortality antepartum bleeding*	*Incidence toxemia of pregnancy (%)*	*Perinatal mortality toxemia of pregnancy*	*Perinatal mortality premature rupture of membranes with latent period > 24 hours*
White						
	I & II	3.9	148	4	44	96
	IV & V	6.7	209	9	55	128
Nonwhite						
	I & II & III	9.1	198	16	65	104
	IV & V	10.5	465	21	79	161

Data from the North Carolina Perinatal Mortality Study.

* Perinatal mortality is defined as rate per 1,000 deliveries of fetal and neonatal deaths of all infants weighing 1,000 grams and more. Neonatal deaths are those which occur in infants less than 28 days of age.

TABLE 2.—*Infant mortality in the United States and abroad*

Country	*Rates per 1,000 live births 1963–64*
1. Sweden	14.8
2. Netherlands	15.3
3. Norway	16.7
4. Finland	17.6
5. New Zealand	17.7
6. Denmark	18.9
7. Australia	19.3
8. Switzerland	19.8
9. England & Wales	20.5
10. Czechoslovakia	21.7
11. Japan	21.8
12. Israel	23.3
13. France	24.4
14. Scotland	24.8
15. United States	25.0
White	21.9
Nonwhite	41.3

When an accidental pregnancy occurs in a family that is ill-housed, ill-fed, and ill-clothed, it is no small wonder that prenatal care is not sought, that prenatal advice is not heeded, and that pediatric care is not utilized. Unfortunately, it is a simple matter of fact that a large proportion of pregnant women are often quite unconcerned as to the outcome of their pregnancy, while many unfavorable environmental factors hinder normal intrauterine and extrauterine development. It is believed that the most important initial step in reducing the high perinatal mortality and morbidity which are present in our large cities is to carry out an energetic and imaginative program of family planning—one that will enable, essentially, every pregnancy to be planned and wanted. This must include a bold and well-planned method of providing conception control to unmarried teenagers who are living in situations of high risk of coitus. Realistic family life education in the schools also must be included. There would immediately occur a dramatic fall in the birth rate which would allow the resources of the family, the obstetric facilities and the prenatal care centers of the cities to be efficiently used to improve and make human reproduction safe for mother and child. The potential of the most sophisticated, well-trained, and well-equipped team of obstetricians, pediatricians, and public health personnel cannot be achieved unless they receive the full cooperation of the parents.

The Study of Previous Reproductive Events and Congenital Anomalies

Crothers and Payne[2] and Lilienfield and Pasamanick[3] have found that the mothers of infants who developed cerebral palsy often had histories of previously unsuccessful pregnancies. Nebel et al.[4] found that 23 percent of the mothers of cerebral palsied infants had previously delivered premature children, while 20 percent of the mothers had had previous abortions.

Data from the North Carolina Perinatal Mortality Study during 1954–64 (Table 3) indicate the great differences in perinatal mortality rates between women who have delivered two or more surviving infants without an abortion or perinatal death and an unfavorable group of women who had at least two abortions prior to the birth which was studied.

TABLE 3.—*Factors influencing perinatal mortality in 19,349 estimated live births*

Factor	*Perinatal Mortality Rate* *Group A*[1]	 *Group B*[2]
I. Marital Status		
Married	27.9	79.5
Unmarried	40.0	68.2
II. Social Status		
1. Most favored	12.2	22.8
2.	18.6	42.1
3.	16.8	58.8
4.	25.2	101.3
5. Least favored		

Data from the North Carolina Perinatal Mortality Study, 1954–64.

[1] Favorable group: women who had delivered two or more surviving infants without an abortion or perinatal death.

[2] Unfavorable group: women who have had at least two abortions prior to birth reported here.

These data make it quite evident that past reproductive history has a great influence on the prematurity and perinatal mortality rate. Undoubtedly, these increased rates are related to many social and medical factors, but they may also be functions of chromosomal abnormalities. It would be important to place mothers who had had previous reproductive failures in a special study group which would receive special preconceptional counseling and studies to determine if chromosomal abnormalities existed among these women and their future offspring.

We are in the infancy of our understanding of abnormalities of chromosomes; we have not yet begun to appreciate abnormalities in the genes. Carr[5] feels that no more than 2 percent of chromosomally abnormal zygotes go to term, but those infants who do go to term generally have major congenital abnormalities. It is conceivable that as our knowledge of chromosomes and genes develops, transabdominal amniocentesis will become a part of routine prenatal care among women who have had previous obstetric failures. It is probable that sufficient knowledge will develop to ascertain if chromosome abnormalities of the fetus are present, and our obstetric management will be sufficiently bold to allow us to abort infants who will have major birth defects.

Congenital anomalies of the uterus are not a great contributor to perinatal mortality and morbidity since major anomalies occur only in one out of every 600 to 700 deliveries. However, faulty fusion of the Müllerian ducts may not allow sufficient uterine muscle hypertrophy and may be a cause of premature labor.[6] The incompetent cervical os also occurs quite infrequently —only once in approximately 1,800 deliveries. Undoubtedly, many operations for an incompetent cervix are performed when the previous abortion was related to factors other than a cervical abnormality.

The Relationship of Social Status to Perinatal Mortality and Prematurity

Many well designed and properly conducted studies of perinatal mortality have indicated that various social factors are closely correlated with prematurity and perinatal mortality. It is difficult to definitively define social classes (Table 1). However, lower social classes of patients generally include women who have had a meager education, have little money, extremely large families, inadequate food and medical care, unplanned and unwanted pregnancies, and short intervals between births.

These factors were quite evident in the North Carolina perinatal mortality study.[7] Although it was found that socioeconomic factors were of primary importance in perinatal mortality, the difference in rates between white and nonwhite groups disappeared when they were adjusted for socioeconomic factors. Indeed, when other variables are held constant, the perinatal mortality among whites in lower social groups is higher than nonwhites of similar social class.[8]

The father's occupation and the mother's education are significantly related to perinatal mortality even when these factors are adjusted for race, age, and parity. Drillien[9] has concluded that the social class into which a woman marries has only a minor influence on her chance of having a premature baby compared with the social class in which she was born and raised. Baird[10] showed higher premature rates and perinatal mortality in smaller women. He felt that height was an associated variable for the socioeconomic status in which a mother was reared. Martin[11] obtained similar data when he studied the pregnancy history of 1,097 primiparas who had given birth to single premature infants and a like number of primiparas who had given birth to mature infants. Premature births were more common among wives of semiskilled and unskilled manual workers.

There is general agreement that illegitimacy is associated with a greater incidence of prematurity and a significantly higher perinatal mortality. Pakter et al.[12] found a higher prematurity rate among white and nonwhite infants born out of wedlock in New York City from 1955 to 1959. Similar data were obtained from Drillien[13] and from the North Carolina Perinatal Mortality Study.[14] It is believed that the high incidence of prematurity among illegitimate births is related to various factors associated with the social classes of the unwed mothers. The majority of these pregnancies occur in young girls who have lived in deprived conditions most of their lives. It would thus seem reasonable to attempt to reduce the incidence of prematurity by providing contraceptive advice and supplies to lower social group girls who have a high exposure rate to coitus. (However, data which are available from Florence Crittenden and Salvation Army Homes indicate that unwed pregnant women and girls who are housed in a protected environment and given security, good nutrition, and reasonable prenatal care have an extremely low rate of prematurity and perinatal mortality.)

It is extremely important for the Public Health Service to provide funds which will allow a properly constructed and statistically valid study of the effect of placing pregnant unwed girls from deprived homes in a proper shelter during pregnancy. If it can be proved that this type of care will reduce the rate of prematurity among these young mothers, the cost of providing this service is extremely small compared to the price of prematurity.

The interval between births is closely correlated with the incidence of prematurity. Moreover, the lower the social class of the mother, the more likely she is to have short intervals between pregnancies. An increase in the interval between births will only occur when adequate family planning services are available.

Maternal Nutrition

Terris[15] has reported an extensive review of the effect of maternal nutrition on prematurity. It is impossible to state accurately whether a relationship does or does not exist between prematurity and maternal nutrition before and during pregnancy. The North Carolina Perinatal Mortality Study was inconclusive in ascertaining whether nutrition was directly related to the rate of prematurity and perinatal mortality; it suggested that adequate protein intake slightly reduced the incidence of prematurity among deprived patients. Brewer[16] feels there is a strong correlation between nutrition and the incidence and severity of toxemia of pregnancy.

There is a tremendous need for sophisticated studies to be made which will allow proper evaluation of the effects of trace elements, vitamins, protein, and minerals upon the outcome of gestation. A properly selected sample of high risk patients could be provided with one supplementary meal a day which contained all the known nutritional requirements of pregnancy. The control group would receive similar obstetric care but would not receive the supplement.

Psychosomatic Factors Associated with Pregnancy

It has been suggested that psychosomatic factors are associated with the incidence of abortion and premature labor. However, if it is difficult to determine the effect of poor nutrition on pregnancy, it is, at present, nigh impossible to show a positive correlation between psychosomatic factors and pregnancy outcome. It is conceivable that properly designed psychological interviews could be constructed to ascertain the relationship between anxiety and pregnancy outcome. Cigarette smoking is one index of anxiety; however, its effect upon pregnancy is probably more related to the effect of nicotine on uterine blood flow than upon basic underlying psychosomatic problems. Frazier[17] has reported nine studies concerning the association of cigarette smoking and infant birth weight. There is a consistent relationship between cigarette smoking and birth weight of the infant. Smoking mothers generally have infants one half to one pound lighter than nonsmokers; however, the neonatal mortality rate is not increased among smoking mothers. Data continue to be accumulated on this problem, and it is possible that smoking mothers will have a higher incidence of antepartum bleeding which will contribute to the incidence of abortion and prematurity.

There is a positive correlation between drug addiction and prematurity; over 50 percent of mothers addicted to opium products deliver premature infants. It is possible that definitive data will soon become available which will clarify the effects of LSD on chromosome abnormality.

Mother's Age, Height, and Weight

It would appear that the preferable time for having children is between the ages of 20 and 30 years. The North Carolina Perinatal Mortality Study[14] indicated that perinatal mortality was highest in both white and nonwhite mothers younger than 15 years of age (Figure 1).

This group of mothers is numerically small, but a high perinatal mortality rate for this age has been observed by others.[18] It was found that the perinatal mortality rate among nonwhite mothers falls to about 5 percent at the age of 18 and remains level until 20 years of age. The perinatal mortality among white women, however, decreases consistently each year to the age of 20; it is then approximately 2½ percent. A constant relationship was also found to exist between perinatal mortality and parity (Figure 2). When all ages are considered, a high perinatal mortality is noted in the first pregnancy as compared with the second, third, and fourth. Following this, the mortality begins to rise, and rises sharply after the sixth pregnancy among patients below the age of 20.

As would be expected there is an extremely high rate of illegitimacy

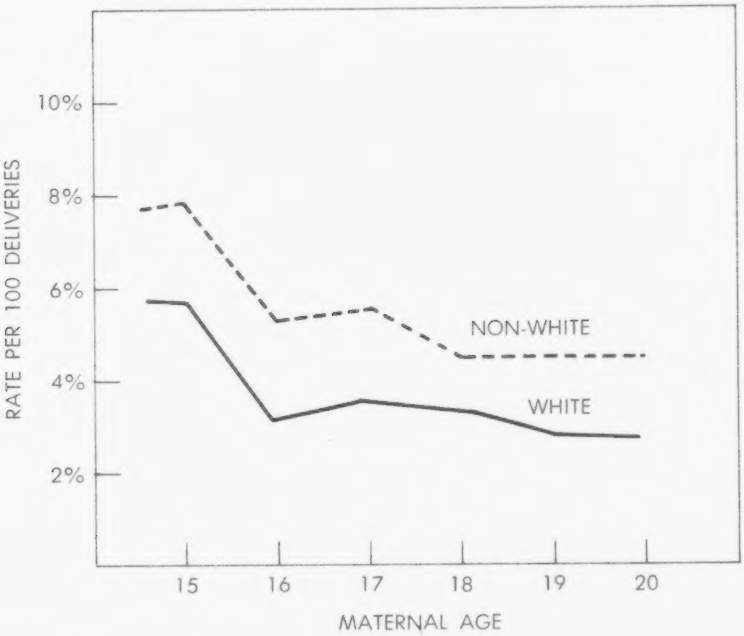

FIGURE 1.—Perinatal mortality rates by race and age of mothers under 20 years of age.

among patients below the age of 20. Essentially, the illegitimacy rate for unmarried pregnant nonwhite patients 15 years and under was 95 percent; the rate was 38 percent for white mothers. Prematurity and toxemia of pregnancy were largely responsible for the increased mortality observed among women under 20 years of age. Semmens,[19] however, found that teenage patients who were married and received prenatal care in a well-disciplined hospital program had a satisfactory pregnancy outcome.

Figure 3 illustrates the preferable years of conception in relationship to aging; it indicates a rise in perinatal mortality among white and nonwhite primiparas and multiparas after the age of 30.

Many factors contribute to this rise in perinatal mortality. Constitutional diseases, such as hypertension and diabetes and various medical complications of pregnancy, tend to occur more frequently in the older age group.

Hydrocephalus, mongolism, Kleinfelter's syndrome, and chromosomal defects caused by nondysjunction occur more frequently after the mother is 30 years of age. Mental retardation is slightly higher in infants of mothers under 20 and women with parity greater than 4. Conceivably, mental retardation is also associated with the population groups who have high parity and teenage pregnancies.

The increase in fetal and neonatal deaths which are associated with women above the age of 30 and/or patients who have chronic hypertensive disease and other constitutional diseases requires a critical study. Scandina-

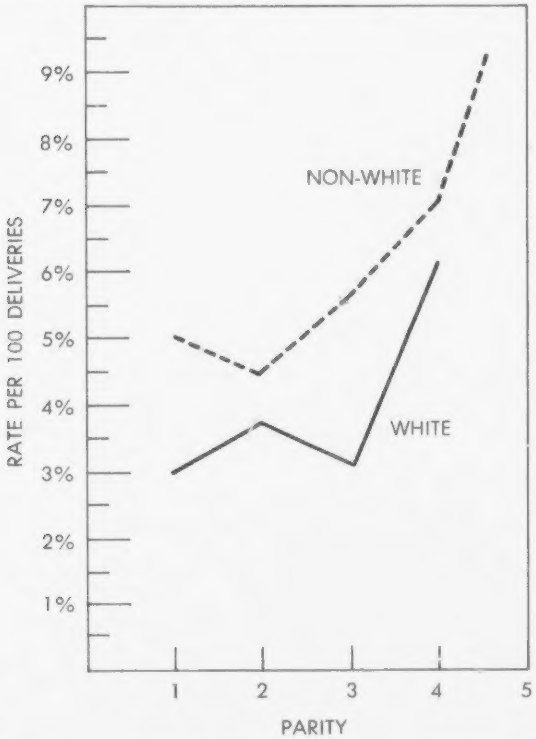

FIGURE 2.—Perinatal mortality by parity and race in women under 20 years of age.

vian health departments believe that one of the reasons they have an acceptable perinatal mortality rate among these high risk mothers is the practice of providing homemaker service, rest, and work leaves to pregnant women. A properly designed study is indicated if we are to evaluate the effects of work upon high risk patients. By proper selection, a group of women could be given homemaker service and allowed to rest at least 4 hours per day. The premature rate and perinatal mortality rate of those patients who received homemaker service and rest could then be compared to a similar group of women who received the same prenatal care but who were not provided with homemaker services. If it can be shown that the cessation of employment, the use of homemaker services, and increased rest could appreciably lower the prematurity and perinatal mortality rate among high risk patients, a significant addition to prenatal care would be apparent.

Maternal Infections

There is a definite relationship between socioeconomic status of prenatal patients and the incidence of bacteriuria. The incidence is significantly higher in lower social groups and often antedates conception.[20] There appears to be no positive correlation between the incidence of bacteriuria and

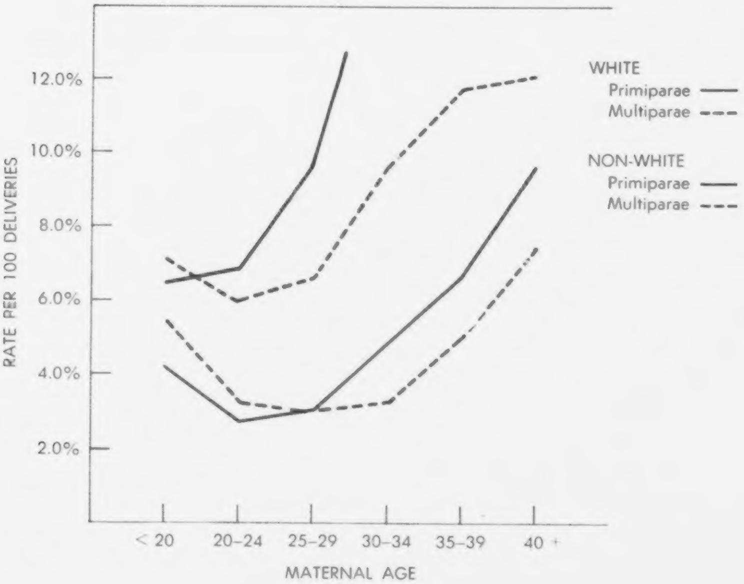

FIGURE 3.—Perinatal mortality for all births in study hospitals by race, parity and age (1954–57, Source: Vital Statistics, North Carolina, 1954–57).

prematurity. However, there is a higher incidence of pyleonephritis among patients who have bacteriuria; the renal infection may be associated with premature labor. Routine prenatal care now requires one or more clean catch specimens to be collected during pregnancy. Intermittent treatment for a specific occurrence of bacteriuria is preferable to continuous therapy; the fetus may be adversely affected by the continuous use of antibiotics.

Syphilis is increasing throughout the world as well as in the United States. Untreated early syphilis complicating pregnancy may become a major cause of mid-trimester abortion, fetal death in utero, and a significant cause of perinatal mortality among the lower social groups who have a high incidence of the disease. If the infection exists 1 or 2 years prior to or at conception, the fetus will probably be seriously affected unless the mother is vigorously treated. It is important to appreciate the rising incidence of syphilis and to obtain serologic tests for syphilis at an early obstetric visit and at each trimester among lower social groups. All mothers who have this disease should receive vigorous and appropriate treatment.

There are a number of other maternal infections which may be present at the time of conception and which can have a marked influence on the rate of prematurity and perinatal mortality. These are cytomegalic inclusion disease, toxoplasmosis, tuberculosis, and malaria. Unfortunately, there is no treatment for cytomegalic disease. However, if toxoplasmosis is present or has been demonstrated in a previous pregnancy, sulfonamides may be of some effect. Fortunately, the advent of antituberculosis drugs has reduced the seriousness of this condition among prenatal patients. It is important, however, to diagnose the disease early in pregnancy and to advise women to receive active therapy, as well as to avoid pregnancy until the disease has been arrested for 2 to 3 years. Patients who have severe untreated tuberculosis generally have a higher incidence of prematurity and perinatal mortality than nonaffected patients. Malaria is not a serious problem in the United States; however, its association with prostration and a high fever may adversely affect the oxygen transfer across the placenta, thus contributing to a high rate of prematurity and perinatal mortality and morbidity.

Maternal Diseases

There are a number of maternal diseases which, if present at the time of conception, may have a profound effect upon the rate of prematurity and perinatal mortality. One of the classic examples is diabetes mellitus. A successful outcome of a pregnancy complicated by diabetes can best be achieved when there is an intelligent, well-motivated mother who will adhere to the advice of an obstetrician who exercises good medical judgment and an internist who is interested in and knowledgeable about this complication of pregnancy.

When diabetes complicates pregnancy, perinatal mortality is increased approximately fourfold. The extent of this increase will be determined by the duration of the disease, the age of the mother and the obstetrical and medical complications which are present, and the extent to which the pediatrician appreciates the complexities of the metabolic abnormalities in the newborn.

It is natural for hypertensive vascular disease to have a profound effect upon prematurity and perinatal mortality. One of the most critical requirements of a pregnancy is the maintenance of adequate placental perfusion. Degenerative vascular disease may markedly restrict placental blood flow and critically affect renal and placental function. The precise effect which chronic hypertension will have upon perinatal mortality depends upon the age and weight of the patient, the parity, and the severity of the disease. There is a geometric rise in perinatal mortality with each addition of one of these conditions. Jones[21] found that uncomplicated hypertension is associated with a perinatal mortality of approximately 8.5 percent; however, when there is superimposed toxemia of pregnancy, it may exceed 20 percent.

Renal disease may have an unfavorable effect upon pregnancy outcome since a kidney damaged by glomerulonephritis or pyleonephritis is generally associated with hypertension. The stress of pregnancy adds to the compromised renal system and may necessitate the production of increased amounts of vasopressor substances which comprise renal and placental function.

Heart disease is associated with an increased rate of prematurity and perinatal mortality. The reduction in cardiac output may influence placental perfusion, decrease the oxygen gradient across the placenta, and cause increased uterine irritability. The major improvements in the surgical management of heart disease make it preferable for patients who have significant and operable cardiac abnormalities, either congenital or acquired, to have these conditions corrected prior to pregnancy. However, when minor heart disease, diabetes, and hypertension are complications of pregnancy, they may be successfully managed with rest, frequent hospitalizations, homemaker services, and good prenatal care and instruction without materially increasing the rate of prematurity and perinatal mortality.

Hyper- and hypothyroid disease are infrequent in pregnancy; when they are managed with appropriate surgery and/or medical treatment, they should not appreciably increase perinatal mortality.

Summary

In reviewing pregnancy antecedents which may influence the rate of prematurity and perinatal mortality, it is evident that many factors exist prior to or at the time of conception that may markedly alter the outcome of a pregnancy. The data from many well-designed and properly controlled studies indicate that, theoretically, the most favorable conditions for a pregnancy would be: Both parents should plan and desire the pregnancy; they should be between the ages of 21 and 25 and be of average height, weight, intelligence, and affluence; there should be no previous history of a reproductive failure or of medical diseases or infections. Such selective breeding is impossible in a democratic society. It is important, therefore, for us to think objectively as to how we may improve pregnancy antecedents and make the United States a safer place to bear children. The philosophy and techniques of prenatal care must be boldly and imaginatively altered if we are to reduce the rate of prematurity and the perinatal mortality rate in many of our rural and metropolitan areas. Three very important projects should be statistically designed and studied by random selection techniques. These are: (1) a study of the effect of nutrition on all pregnancies, but particularly teenage pregnancies; (2) the study of the effects of homemaker services on high risk mothers; and (3) a study of the effects of a sheltered environment for pregnant unwed teenagers.

Our emphasis should be on preventative obstetrics. It is here that our battles against prematurity, cerebral palsy, mental retardation, and a high perinatal mortality rate will be won or lost.

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PANEL DISCUSSION

RESPONSE
by

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Dr. Flowers has made a real contribution in noting that race is unimportant when social class is defined equally; in fact, perinatal mortality is higher in white parents of low social groups than in nonwhite.

It would be desirable for the British observations of Drillien and Baird to be brought up to date and to be compared with a series of American pregnant women in various social classes.

The differences in obstetrical care between the British and American medical professions, such as almost universal prenatal care in Britain, may or may not become evident. Although the figures for infant mortality show that England and Wales are in ninth place, Scotland is only 0.2 of a percentage point ahead of the United States. These figures are for deaths during the first year of life and include neonatal deaths but not antenatal deaths.

Dr. Flowers' suggestion that the Public Health Service provide funds for proper housing for pregnant unwed girls is an excellent one. The recognition of their special needs in the field of education is a hopeful sign of progress. Baltimore, for example, has two public schools, entirely populated by pregnant girls, where prenatal care is urged and the principles of good nutrition taught. The controlled nutritional study which Dr. Flowers describes could be carried out under such circumstances.

One wonders whether the high perinatal mortality rate in the first pregnancy in teenagers is related to an underdeveloped uterus or to an immature endocrine system. The reasons are probably different from those responsible for the rise after the third pregnancy.

In Figure 3 (page 00), if the top two lines are for the white population, it appears that perinatal mortality is lowest in the white primipara before 20 years of age. For the nonwhite primipara, the 20 to 24 year age span is optimal. Here, again, especially when dealing with prematurity, it would be desirable to know whether maternal age means age at conception or age at delivery.

Dr. Flowers suggests a study of homemaker services and work leaves for older women. I believe this type of study has been done in the Scandinavian countries, and the success of these practices is such that they are continuing. There is, I feel, no counterpart for the other two studies Dr. Flowers suggests: nutritional influences, especially on the teenager, and proper environment for the pregnant unwed teenager.

The goal—preventive obstetrics—is admirable, but will be attained more quickly and thoroughly by improved health education in the schools, even starting with kindergarten. Increasingly more educational tools, such as filmstrips, movies, and closed TV, are becoming available to teach young people to be receptive to the idea of prenatal care.

Dr. Gold has an excellent maxim which I have heard more than once: prenatal care begins on the first day postpartum. This is an admirable idea, for it may be the last time that the mother is seen before her next labor. The number of drop-in deliveries in tax-supported hospitals in the East ranges from 30 to 60 percent. But this girl is already in line to be a multipara. What about the primiparous girl?

We shall assume the ideal situation in which marriage precedes pregnancy (knowing full well that this is not the case in about 30 percent of pregnancies). With the realization that heredity plays an increasingly large part in the background of congenital anomalies (including about half of mental retardation), either directly or by interaction with environmental factors, I believe the most useful information that parents can pass on to their children is as complete a health history as possible or their own health, the children's health, and that of siblings, grandparents, aunts, uncles, cousins. A leveling book in this respect is McKusick's *Mendelian Inheritance in Man*, which catalogues 1,487 different inherited conditions, 53 percent of which are thought to be an autosomal dominant pattern in which only one parent need carry the deleterious gene or genes; 39 percent autosomal recessives in which both parents are involved, though apparently entirely healthy; and 8 percent sex-linked conditions in which the mother carries the gene and passes it on to her sons. And this is just the *first* edition!

How helpful it would be to know at least the Rh and ABO blood groups of the parents. Even though control of erythroblastosis due to Rh incompatibility is close at hand, considerable peace of mind could be brought to couples in eight out of nine marriages by knowing that there is no Rh incompatibility. Is there a history of recurrent spontaneous abortions in the family? Or of premature births? Or of toxemia? Though poorly understood, these events are more frequent in the next generation. Did either parent have an operation to correct a heart defect? In Helen Taussig's personal observations of two generations, the incidence of congenital heart defect increased sixfold in the next generation, from 0.3 percent to 1.8 percent.

Under certain conditions, chromosome examinations and certain enzyme determination of the future parents should be performed, hopefully in state health department laboratories. In an ever-growing number of conditions, the heterozygote can be identified by laboratory methods. The increasingly common condition, cystic fibrosis, has proved a challenge in this respect. The determination of the sodium content of sweat has not proved to be as useful as expected in separating normal parents from heterozygotes. Radiation of nail fragments and the determination of their sodium content was the next step. A new test using tissue culture methods looks hopeful; fibroblasts from carriers of the gene take on different staining properties from those of normal people. A similar test can be used for Hurler's or Hunter's syndrome.

Dependent on the family history, consultation with a genetic counselor may be indicated. At present, for the most part, this type of work is available sporadically by interested research groups, but a few states now offer such services as do many of the Birth Defects Centers supported by the March of Dimes.

The future father is all too often omitted from consideration in the quality of his offspring. Of increasing importance is his exposure to radiation, whether in radar work in military service or in nuclear power plants. Chromosome monitoring has been underway for several years at Shippingport, Pa. A small, long-range study at Oak Ridge shows a persistence of chromosome errors in men who have survived accidental nuclear exposure. To my knowledge, no abnormal infants have been born as a result, for infertility prevents such an occurrence. It seems logical that some type of lead-lined underwear should be developed for men at risk.

Along these lines, in spite of splendid developments in making X-ray machinery safer, it still appals me how little attention we pay to the gonads of premature infants as their chests are X-rayed for respiratory distress syndrome. I too am at fault, for, many dozens of times over 25 years, in holding a premature infant vertical for the proper X-ray, not once were the ovaries or testes protected with a small piece of lead.

A word about mongolism, trisomy 21, Down's syndrome. This common birth defect seems nearer than most to solution—by prevention. At least three theories of etiology seem worthy of consideration, excluding the 5 percent or so who have an inherited translocation.

In 1960, the suggestion was made by Canadian investigators that a mongoloid offspring was produced much more often—4½ times as often—by women who had been subjected to abdominal X-rays before conception, as compared to neighboring control women. Partly because of the negative experience with monogoloid births after the Hiroshima and Nagasaki radiation exposure, this idea was not generally accepted. But, in 1965, even stronger evidence was presented. In Baltimore, the history of such exposure was 7½ times as great in the mothers of mongoloids. Also, in this study, the fathers were found to have been in radar service more often than normal controls. Thus, radiation damage to germ cells before conception is one of the possible causes of mongolism.

For 25 years, Collman and Stoller, in Victoria, Australia, have carefully mapped the time and location of each mongoloid birth in that state. Superimposed on this, they have placed the curves of infectious hepatitis epidemics 9 months earlier. They feel that there is a causal relation of these two events. Four other attempts to duplicate their study have met with negative results in other parts of the world. The question will be nearer solution this

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year and next, for there is apparently an epidemic of infectious hepatitis in Victoria now, and Collman and Stoller predict more mongoloid births next year.

Ample evidence exists that virus infections can upset cell division. The latest work on "small for dates" rubella babies suggests that this is associated with a definite hypoplasia of many organs, a definite decrease in cell numbers. This finding is also true with the "small for dates" babies of malnourished mothers, according to a study underway in Chile. It is possible that the deficiency in cell numbers in rubella babies is related to chromosome aberrations due to the virus infection and loss of these cells, since they cannot reproduce and die. Mental retardation in these babies may be a direct result of too few brain cells.

It is common knowledge that mongolism is much more frequent in infants of older than of younger women. A possible hypothesis for this was recently proposed. This hypothesis is subject to proof or disproof through epidemiologic studies which are already underway. The egg and the sperm in any species have an optimal time for fertilization. Present knowledge indicates that for the human being, this time is between 0 and 24 hours. For another 12 hours or so, fertilization may still take place, but with the risk of degenerating meiotic apparatus. The obvious implication is that it would be well to have fresh sperm awaiting the freshly ovulated egg. The hypothesis proposes that the changing sexual habits of couples who have been married a long time are very different from those recently married; this is borne out by several studies. In the Kinsey study, the average number of days a week in which intercourse took place the first year of marriage was 2.5 and, after 15 to 20 years of marriage, 1.3. This normal pattern of sexual life may be responsible for an increased incidence of fertilization of a degenerating egg and, consequently, the occurrence of more spontaneous abortions and the birth of babies with chromosome aberrations, of which mongolism is one of the most common. This hypothesis remains to be proven. Prophylactic measures are included in the broad term "family planning." It is suggested that when conception is definitely sought, intercourse should take place daily or at least within 48 hours during the time of ovulation. This, of course, is the unknown quantity, but the period 10 to 20 days after the LMP would cover the large majority of women. As new methods are found for pinpointing ovulation, this time can be shortened.

The other aspect of family planning—contraception—presents another problem. There are rumblings on both sides of the Atlantic that all is not well with the use of pregnancy tests involving the administration of steroids. Many questions are being raised as to the intermittent use of steroids for contraception with the possible masculinization of the female infant. Much more data are needed, and, until they are available, it is suggested that contraceptive pills, if used, be taken faithfully, not intermittently; that pregnancy tests be chosen which do not involve steroid administration to the potential mother; and that when a couple decide to have a baby, intercourse should take place at least every 48 hours.

Lest it seem that I have lost interest in the perinatal period, it is gratifying to see the expanding new knowledge in this field. I heartily recommend the American Academy of Pediatrics Seminar on Neonatology as a gold mine of information. This title will soon be changed to perinatology. Fetology waits in the wings. One new diagnostic tool for the conduct of labor is Saling's method of drawing blood from the fetus near the end of the first stage of labor and its analysis for acid-base balance constituents. If the mother is not acidotic, the degree of metabolic acidosis correlates directly with the newborn score at birth and often leads to prompt obstetrical judgments so necessary to prevent permanent damage to the brain of the fetus.

RESPONSE

by

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There is little in Dr. Flowers' presentation with which I would disagree, and the coverage he has provided is so adequate that very little remains for me to add.

The suggestions I should like to make relate primarily to the social aspects of reproduction and to our efforts to compensate for deficiencies in money, education, motivation, nutrition, cultural and ethnic patterns, etc.

Many reasons exist for the reported high rate of prematurity and perinatal mortality in the United States in comparison with other nations. These reasons involve many factors that are difficult to evaluate.

Certainly, one of these factors is the role of better vital statistics in the United States. For example, we know little or nothing of the perinatal mortality of the Laplanders or the Eskimos in northern Canada, while we have considerable information about the underprivileged people of minority groups in the United States. Likewise, our statistics for pregnancies ending in premature births and perinatal mortality, etc., would be quite different if many pregnancies were terminated by abortion as in Japan and some of the Scandinavian countries. The definition of live birth and fetal death as determined by the World Health Organization is not uniformly followed or interpreted. All of these factors have some effect on the statistical status of the United States relative to other countries.

Also, in comparison to other countries, the population of the United States is far from homogeneous. We have a large number of minority groups, and there is a great deal of unstructured crossmating which produces many social, cultural, physiological, and clinical problems. It seems feasible to anticipate that, as other countries acquire large numbers of minority groups who intermarry with various segments of the dominant population, some of these problems will be experienced elsewhere.

In addition to the problems of population types, we do not share a homogeneous culture or educational background. In the United States, tremendous variations exist between the impoverished individuals of the bayous, the Indians living on the reservations, the minority groups in the slum areas of

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the big cities, and the dominant population. All of these factors considerably enhance the incidence of reproductive accidents and failures. It is regrettable but true that the United States has more of these forces which adversely affect the prematurity and perinatal mortality problems.

A basic problem faced by the gynecology-obstetrics discipline relates to the concept that pregnancy is a 9-month physiologic alteration in the life of a woman. It is not uncommon for individuals of the deprived minority groups to seek medical care at midpregnancy or later. This means that the obstetrician is asked to correct in 6 months or less a lifetime of medical and social inadequacies. Gynecology-obstetrics should begin with the birth of a newborn girl, or certainly at puberty. Unless the medical, social, and cultural life of this individual can be modified from such an early date onward, it will not be possible to make a significant impact in 3 to 5 months of the course of a later pregnancy. It is remarkable that an obstetrician is able to accomplish as much as he does in lowering both maternal and perinatal mortality and morbidity under the circumstances in which he is so often required to function.

The gynecologist-obstetrician should become the primary physician for all females, beginning at least at the time of puberty and continuing throughout the patient's life. It is only the gynecologist-obstetrician who looks on these young girls as future mothers and not as patients with heart disease or measles, or some other complication. Our thoughts, approaches, and the other parameters of our clinical discipline keep this basic physiologic-biologic function of young women strictly in the forefront.

Then there is the tremendous variety in the mating and breeding habits of individuals in our country. In the "old days," when a semiselective mating process was employed in which the bride was selected by the parents of the groom, some degree of uniformity of the pairing process was accomplished. Today, the high mobility of our population and the emphasis on physical attractiveness have led to all varieties of premature sexual activities and to pregnancies in early teenagers and preteen girls, so that the processes of reproduction are almost totally uncontrolled.

Much reliance has been placed on sex education, emphasizing its importance in schools and elsewhere. I believe that this approach is grossly overrated, and many people are losing confidence in such emphasis. I cannot conceive of sex education, as such, being useful in the majority of the problems which we face. For example, sex education is not what is needed for the woman who has four or five or even seven pregnancies out of wedlock. Even the young teenage girl learns by various methods that sexual intercourse is the means by which pregnancy occurs, and she also knows that contraception is available. The problem is not in education, but in some mechanism of providing self-discipline which will limit *unprotected* sexual activity.

The basic problem, then, seems to be some form of contraception or sterilization. There are still many gynecologists and family planning clinics that refuse to provide contraceptive information to unmarried girls and women, and that place many other forms of limitations on these individuals who are exposed to potential sexual relations and pregnancy. While increased sterilization of the male is probably helpful, I am inclined to believe that this

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avenue of approach is not too useful in our highly promiscuous society. Akin to this is the fact that many people consider pregnancy to be evidence of sexual prowess. This applies both to the male and female, and is particularly strong among the underprivileged. We have had many of the boys in the underprivileged minority in our community bring their girl friends in to have intrauterine devices removed. The boys believe that the failure of the girl to conceive casts a shadow on their virility and masculinity.

Finally, it seems to me we should increase the use of abortion for a variety of reasons other than medical. Certainly, many of the problems of Japan, Sweden, and elsewhere have been solved by this route. How many perinatal deaths have been avoided by the use of abortion is unknown. I have no evidence that the deaths produced by abortion are calculated in the perinatal death rate or the pregnancy wastage rate. Abortion for social and economic reasons and even for health reasons as opposed to life-saving reasons are not permitted in most parts of this country; hence, some cases of perinatal death, prematurity, or mental retardation, that would not have occurred in other countries, are counted as a part of our perinatal problem.

The various problems I have mentioned are not basically medical. They are ethnic, social, cultural problems on which the physician has a very limited effect. Thus, the remedies for prematurity and perinatal mortality are cultural, social, ethnic, and, to some extent, financial. Education is frequently put high on the list of deficiencies that cause these problems, but our experience indicates that this is a relatively unimportant part of the problem with which we are concerned. Thus, we have ample evidence that while the gynecologist-obstetrician can advise and point out the areas of the problems and can contribute his clinical skills to their solution, he cannot influence to any large extent the outcome of the particular problems. Their solutions, as I have pointed out, lie in the cultural, social, ethnic, and financial areas. For evidence of this, all one needs to do is compare the outcome in the average private practice as opposed to the staff or clinic practice.

Until we can understand why many adolescents drop out of school and can formulate successful remedies for this, we will not significantly affect the prematurity and perinatal mortality rates and out-of-wedlock pregnancies of the underprivileged. Undoubtedly, the same motivational deficiencies which lead the young girl to drop out of school permit her to accept the hazards of pregnancy and to fail to seek adequate obstetric and health care.

RESPONSE

by

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Dr. Flowers suggests that high perinatal mortality and morbidity rates (and by implication, prematurity rates) can be reduced by imaginative family planning programs. One cannot argue with this concept. Obviously, the absence of pregnancy will not only reduce the incidence of prematurity and its sequelae, but will eradicate the problems. While family planning must, and should, be an integral part of total maternity care, I believe the challenge to the obstetrician is to reduce prematurity once pregnancy, wanted or unwanted, planned or unplanned, occurs. The prevention of prematurity necessitates the determination of etiologic factors and then treatment or even reduction in the frequency of these factors.

Dr. Flowers discussed many of the sociocultural factors associated with prematurity and perinatal mortality and morbidity. These most important and significant considerations have been, and will be, discussed in depth by others. At this time, I would like to direct my attention to what are generally considered to be obstetric factors or antecedents in prematurity.

Data from various clinics, as well as our own, indicate that a very large proportion of premature labors are without explanation. When obstetric antecedents are present, they may be directly etiologic, or indirectly, in that treatment of the condition involves termination of the pregnancy.

In March of 1947, Dr. Nicholson J. Eastman published an article entitled "Prematurity from the Viewpoint of the Obstetrician." Except for progress in epidemiology and statistical studies and, perhaps, some conceptual changes regarding delivery of obstetric care, little has been added in these 20-odd years, and his paper remains a classic, his comments pertinent and germane to this discussion. Dr. Eastman emphasized that simple association of premature labor and some complication of pregnancy does not necessarily mean that the complication was the cause of the prematurity. Such a causal relationship can be postulated only if it can be shown that a given complication precedes premature labor much more frequently than would ordinarily be expected. He suggested a method of analysis used by us to study our premature deliveries for a 2-year period, 1963–65. During this time, we had 11,513 deliveries and 1,791 prematures (15.6 percent) (Table 1).

Table 1.—*Incidence of prematurity (1963–65)*

Total Deliveries	11,513
Prematures	1,791 (15.6%)

The method of analysis used is illustrated in Table 2. The first column is the total number of cases; column 2 is prematures expected (overall rate); 3 is actual number of prematures that occurred; column 4 is the percent found; and column 5 (3–2) is prematures due to disease. Column 4 is the risk factor for prematurity in any given complication.

The findings for mild preeclampsia, the most common complication listed, indicate that this condition is rarely the cause of premature labor, since the 16.2 percent of prematures found is not significantly higher than the

Table 2.—*Role of various conditions in causing prematurity*

Single pregnancies only	(1) *Total cases*	(2) *Prematures expected*	(3) *Prematures found*	(4) *Percent found*	(3–2) *Prematures due to disease*
Mild preeclampsia	789	123	128	16.2	5
Severe preeclampsia	91	14	38	41.8	24
CHVD	319	50	99	31.0	49
Eclampsia	12	2	6	50.0	4
TBC	195	30	30	15.4	—
Heart disease	231	36	37	16.0	1
Diabetes	43	7	9	20.9	2
Abnormal GTT	35	5	5	14.3	—
Rubella	22	3	5	22.8	2
Neuro-Psych.	331	51	100	30.2	49
Surgical comp.	35	5	14	40.0	9
Myoma	44	7	9	20.5	2
Ovarian cyst	22	3	5	22.7	2
Congenital anomaly	4	1	2	50.0	1
Cervix, malignant	15	2	4	26.7	2
Hydramnios	37	6	13	35.1	7
Hyperthyroidism	21	3	9	42.9	6
Pyelonephritis	143	22	37	25.9	15
Nephritis	9	1	6	66.7	5
Syphilis, untreated	61	9	11	18.0	2
Other med. comp.	29	5	6	20.7	1
Rh isoimmunization	47	7	7	14.9	—
Placenta previa	57	9	29	50.9	20
Abruptio placenta	124	19	79	63.7	60
Other antepartum bleeding	97	15	58	59.8	43
Prolapsed cord	80	12	25	31.3	13
Incomp. cervix	16	2	12	75.0	10
Previous C. section	203	32	83	40.9	51
					385 (21.5%)

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15.6 percent expected. (This sentence, except for the figures, is lifted verbatim from Dr. Eastman's paper.) Severe toxemia, eclampsia, and CHVD would seem to be significant etiologic considerations.

Antepartum hemorrhage of all types was associated with an extremely high incidence of prematurity. Other common conditions apparently of significant etiologic relationship include neuropsychiatric disorders and repeat cesarean section. Less common complications frequently associated with prematurity include nephritis, hyperthyroidism, and incompetent cervix. Our data would indicate that heart disease, diabetes, syphilis, and miscellaneous medical complications are not etiologically significant in prematurity.

If we add up all the known causative factors in our series, we can demonstrate that 385 prematurities were due to disease (21.5 percent). Even when premature births due to congenital anomalies and multiple pregnancy are included, approximately 60–65 percent of them are unexplained insofar as obstetric antecedents are concerned.

Prevention

Until we know more about this larger group of prematures, we can only make progress by preventing or treating those conditions in the smaller group which are identified as having an etiologic relationship. In many instances, improvement is feasible. A patient profiled as low risk—white, in her twenties, average in stature and weight, well educated, married, a nonsmoker, RH positive, and free of medical disorders—has a one in a hundred chance of giving birth to a premature. If she receives prenatal care, chances for a premature delivery increase since a significant number of such deliveries are caused by physicians, either by too early induction or repeat cesarean section. These are preventable prematures.

Toxemia can be prevented, or at least ameliorated, by proper obstetric management. The work by Hibbard suggests that abnormal folic acid metabolism is related to placental abruption and other antepartum bleeding. Our own recently published study on this subject supports this concept and indicates that folate metabolism may be important in toxemias as well. This area of investigation may lead to methods to reduce the incidence of these complications. The conservative management of placenta previa should result in lowering the incidence of prematurity from this complication.

Multiple pregnancies can be detected earlier, affording us the chance to place the patient on bed rest and by lengthening the period of gestation. While the incidence of incompetent os syndrome is low, this is another condition subject to correction and improved results.

Prenatal Care

The comments on prevention indicate the areas wherein prenatal care can be effective in reducing prematurity and perinatal morbidity and mortality. This statement runs against the current tide; the vogue today is to say prenatal care is of little or no importance. What I fear is an overreaction to statistical studies indicating that there is little value in prenatal care.

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It is true that prenatal care cannot overcome the deprivation and deficits of a lifetime. It is true that in Scotland, where all women receive adequate prenatal care, the gap in infant mortality rates between high and low socioeconomic classes is growing. However, it is also true that proper prenatal care can identify high risk patients not only for a current pregnancy but for future pregnancies and preferably at the end of prior pregnancies. This extends the concept of prenatal care to include interconceptional care. We must prevent women from reaching pregnancy in a state of high risk. Prenatal care must not only observe and record, but take action after study to affect the total environment of the mother and fetus. In addition, modern obstetric care must insure better continuity of care—from prenatal care to management during labor and delivery. Decentralization and satellite clinics have inherent dangers.

Although prenatal care may do little to alter the outcome of a particular pregnancy, only by total maternity care service programs, combined with investigation of high risk patients, can we hope to find solutions. Our own experience in a high risk M & I project supports this position (Table 3).

TABLE 3.—*Maternal and infant care program; New York Medical College–Metropolitan Hospital Center; fetal outcome*

	1966 (%)	*1967* (%)
Perinatal Mortality	80.3	49.7
Prematurity	21.9	15.5

I would, therefore, recommend the following. We must:

- Emphasize the positive aspects of prenatal care as a part of total maternity care.
- Encourage the establishment of Maternal and Child Health Centers that are service oriented but with applied research and education.
- Establish control and evaluation procedures for high risk programs.
- Improve obstetric practices in order to reduce iatrogenic causes of prematurity and to correct identifiable obstetric causes.

RESPONSE
by

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It has been said many times that mental retardation is a symptom. As is true of all other symptoms, there are a variety of causes. Some causes of mental retardation are concerned with adverse environmental factors during childhood that may jeopardize the normal development of intelligence. Adverse environmental factors may be sociocultural and related to home or other social conditions which fail to provide the child with opportunities for learning. However, this Conference emphasizes the importance of reproductive factors in the etiology of mental retardation. Some of the reproductive causes of mental retardation are genetically determined. Others are related to the perinatal period of conception and intrauterine growth and development. The reproductive etiologic factors in mental retardation constitute a large and important group which influence the intrauterine environment of the fetus or affect the fetus or newborn during labor, delivery, and in the immediate neonatal period.

Although most of the reproductive factors are biologic, the quality of

Table 1.—*Etiologic factors in mental retardation*

I. Biologic
    A. Perinatal
        1. Prematurity
        2. Anoxia
        3. Birth trauma
        4. Isoimmunization
        5. Maternal disease
        6. Infections
        7. Malnutrition
        8. Drugs
        9. Irradiation
        10. Genetic
        11. Sociocultural
    B. Postnatal
II. Sociocultural

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human reproduction is greatly influenced by the social characteristics of the environment. For example, while the occurrence of a premature birth is essentially a biologic event, there is unmistakable evidence that broader social environmental factors are also implicated. It is abundantly clear that one of the most important reproductive factors in impairment of normal physical and mental growth and development in the child is premature birth. And it must be realized that the hazards of premature birth are increased if the mother is classed as indigent. Therefore, it should be clearly evident that efforts to reduce the hazards of premature birth should be directed primarily to that segment of the population where the problem has the greatest incidence and the greatest effects—the indigent.

Approximately 6,000 indigent expectant mothers deliver each year in our large charity hospital in Atlanta, Georgia. Our Maternal and Infant Care project was started in 1965. In the last 2 years, we have had the lowest maternal mortality rates in the history of the hospital. However, our premature birth rate continues to creep up from year to year. Since there are so many factors associated with the delivery of a low birth weight infant, and the importance of each factor is difficult to assess, we have been unable to explain with certainty the reason why the premature birth rate is increasing. It is not related to an increasing number of unregistered patients, since that number has declined from 30 percent in 1962 to a present low of 10 percent. Of course, the rates for premature birth, fetal death, neonatal death, and perinatal death are all very much higher in our nonclinic patients, and this is true regardless of weight group.

TABLE 2.—*Grady Memorial Hospital*

January 1, 1965–June 30, 1967

	Clinic	*Nonclinic*	*Total*
1965	5826 (86.9%)	875 (13.1%)	6701
1966	5353 (87.0%)	798 (12.9%)	6151
1st half 1967	2503 (90.0%)	279 (10.0%)	2782

TABLE 3.—*Grady Memorial Hospital*

January 1, 1965–June 30, 1967

	Clinic	*Nonclinic*
Total births	13,682	1,952
Total premature rate	151.0	312.0
Total fetal death rate	14.8	52.3
Total neonatal death rate	17.9	83.2
Total perinatal death rate	32.5	131.1

However, there has been a significant change in our obstetric population that is disturbing and alarming and can be expected to have a continuing adverse effect on our premature birth and perinatal mortality rates. I refer to the very precipitous increase in the number of adolescent and teenage expectant mothers who are presenting themselves for care in our hospitals in greater numbers than ever before.

TABLE 4.—*Grady Memorial Hospital*

January 1. 1965–June 30, 1967
Comparison of percent of deliveries by weight group for clinic and nonclinic patients

Weight (in grams)	501–1000	1001–1500	1501–2000	2001–2500	2501–3000	3001–3500	3501–4000	4001–4500	4501–5000
Clinic	1.1	1.7	3.1	9.3	29.4	36.0	16.1	3.0	0.4
Nonclinic	6.0	5.3	6.9	13.1	27.9	27.5	11.4	1.6	0.5
N-C > C	5.5x	3.1x	2.2x	1.4x	0.95x	0.76x	0.71x	0.53x	1.3x

TABLE 5.—*Grady Memorial Hospital*

January 1, 1965–June 30, 1967
Percent of Perinatal mortality by weight group
13,682 clinic and 1,952 nonclinic patients

Weight (in grams)	501–1000	1001–1500	1501–2000	2001–2500	2501–3000	3001–3500	3501–4000	4001–4500	4501–5000
Clinic	82.8	42.9	16.2	4.3	1.4	.5	.7	.7	8.0
Nonclinic	97.4	69.0	27.6	5.5	1.6	1.5	.9	.0	11.1

TABLE 6.—*Grady Memorial Hospital*

Percent of Deliveries by Age and Race, 1965–66

NEGRO

Age	*1965*	*1966*
16 and under	9.3	11.5
17–20	29.1	32.1
21–24	25.2	22.4
25–28	15.2	14.4
29+	21.2	19.6
	100.0	100.0

WHITE

Age	*1965*	*1966*
16 and under	6.2	8.2
17–20	29.4	31.6
21–24	26.0	24.9
25–28	16.5	14.6
29+	21.9	20.7
	100.0	100.0

In 1966, one out of every three deliveries in our hospital was to a mother 19 years of age or younger. Of these mothers, 666 (9.3 percent) were age 16 or younger. We delivered one 12-year-old and four 14-year-olds who were having their second baby; one 15-year-old was having her fourth baby; twelve 16-year-old girls were having their third baby; two 18-year-old girls were having their fifth baby; three 21-year-old patients were having their seventh child; and three 25-year-old patients were gravida nine or greater. Of the 666 adolescent (16 and under) pregnancies in 1966, 100 were to adolescents who were multigravidas. Also, in 1966, we delivered 369 patients who seemed to have had a pregnancy every year since they began their reproductive career as adolescents.

This is not a new problem for us, or for many of you. Between January 1954 and June 1965, our hospital delivered 5,274 mothers age 16 and younger, an average of 38 per month. However, this number has now increased to 55 per month, even though the total number of deliveries has dropped every year since 1963. I think it is reasonable to explain, at least in part, the increase in our premature birth rate on the basis of the increased number of adolescent and teenage expectant mothers in our obstetric population, since this is a very high risk group for premature birth for us.

Dr. Helen Wallace, in her 1965 report (*American Journal of Obstetrics and Gynecology*, 92:1125, 1965) pointed out that teenage expectant parents represent a high risk group in any community. She stressed that the increased risk is present from a number of points of view—health, social, psychological, educational, and vocational—that teenage marriage is increasing rapidly, that more than half of teenage marriages involve premarital pregnancy, that divorce rates among teenage marriages are three to four times higher than among those married at later ages, and that teenage marriages are the most fertile. Among very young teenage pregnant girls, there is a high incidence of prematurity, neonatal mortality, excessive weight gain, prolonged labor, toxemia, cesarean section, cervical lacerations, inadequate pelvic capacity, venereal disease, malnutrition, and inadequate care during pregnancy. It is reasonable to assume that these factors also lead to a higher incidence of mental retardation in infants born of teenage mothers.

Another special problem of the teenage pregnant girl is that she is forced to leave school because of her pregnancy. Not only does she need a place in the community where she can go for competent and confidential advice and help, but she also needs to be encouraged and to be able to continue her education. Pregnancy is now the most common physical reason for high school dropouts, although it is not known how many of the 8,691 Georgia girls who dropped out in the 1964–65 session were pregnant.

Government officials, educators, and others have directed their attention to the growing problem of "unskilled manpower" caused by the school dropouts, many of whom end up on relief rolls. Within the context of this Conference, there is a more important effect of dropping out of school. This is the even more devastating and growing problem of "unskilled motherpower." Numerous studies have demonstrated the importance of the adequacy of the mother in the intellectual growth and development of the child, and this is especially true when the child is premature.

The adolescent and teenage pregnancy is a syndrome of failure: failure to continue in school; failure to return to school after the pregnancy has been completed; failure to use contraception; failure to be self-supporting; failure to establish a stable family; and failure to achieve a quality performance and outcome of the reproductive process. In spite of diligent effort, our obstetric service (including the M & I project, the Family Planning program, the Socio-Cultural Study Section, the Perinatal Mortality Section, and the Adolescent

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Pregnancy Clinic) is not satisfied with the results. We plan to continue because we feel that for the reasons outlined above, this group represents a "crisis of immediacy." Dr. Flowers apparently holds a similar view.

GENERAL DISCUSSION

Dr. Tompkins: Before opening this session for general discussion, I would like to add several minor points for your consideration.

We have talked about many factors. However, I would like to hear some discussion relative to the patient's basic metabolic and physiologic status at the time she becomes pregnant and during pregnancy, since this can affect maternal and newborn outcome. Of necessity, we must come to grips with some rather fundamental attitudes regarding evaluation of work previously done that has not been referred to. Some of the work published from the Philadelphia study on nutrition in pregnancy should be considered. This study had to be terminated prematurely some 12 years ago because of funding inadequacies. However, present funding could make it possible to further explore some of the provocative ideas that were produced in that study, as well as several others that have previously been reported.

Unfortunately, during the past 12 years, there have not been any definitive studies in nutrition; yet this is one of the most fundamental areas which we must consider.

I am pleased that Dr. Thompson emphasized, and very strongly, the problem of adolescent pregnancy. We are no longer dealing with teenagers; we are dealing with adolescents. In our M & I projects, we are delivering 8- and 9-year-old children. The 10-year-old is still rare, as are the 8- and 9-year-olds, but the 11- and 12-year-olds are no longer uncommon. Physiological maturity in the female has been dropping at the rate of 6 months every 2 decades. We are thus confronted with a totally different problem than heretofore.

Dr. Pearse: I would like to make two additional comments concerning the area of pregnancy prevention. All too often, we equate contraception with family planning, and family planning with population control. None of these are equal. It seems that the suggestion often has been—and perhaps this is true of some of the Federal programs now being promulgated—that we are talking about contraception programs, not family planning programs. In particular, the statement that the goal of the program is "to allow every woman to have as many healthy children as she desires" appears to be the goal of a contraception program and not family planning. The guidelines of one program of the Office of Economic Opportunity, which states specifically that no funds shall be used for any form of sterilization procedures, would be another example of this. Pregnancy planning is most important—but are we going at it realistically? Perhaps this should be considered at this Conference.

Another area of concern to me is that we have placed considerable emphasis on prenatal care, particularly in regard to preventing prematurity. There are some benefits to prenatal care which are supportive to the pregnant woman. Some evidence exists, I believe, that emotional high risk factors in pregnancy can give rise to mental retardation, both during the pregnancy period and, particularly, during nursery isolation of newborn premature infants. This may be an area where prenatal care might more definitely prove to be of help.

Dr. Kaiser: What Dr. Thompson said in regard to the growing number of out-of-wedlock pregnancies among adolescents in the United States is a reflection of the growing number of adolescents. I would like to know if there is any evidence of an age-specific increase in the incidence of pregnancy, or if this simply reflects the fact that we have more young people. Dr. Tompkins, perhaps you know something about the age distribution spectrum of the country which might give us some understanding of why we have pregnant 10- and 11-year-old girls in such recognizable numbers. A related question is: does not pregnancy among adolescents select out the patient at great risk because the majority come from the lower socioeconomic segment of the population? Before we could decide this, we would have to know something about the total number of pregnancies in this group and the relative rates at which these pregnancies are terminated by abortion and by delivery at term.

Dr. Hunt: My impression is that there has been some increase (16 percent) in the total number of young people in the age range, say under 15 years. That is, the growing number of teenage girls 10–14 years in the 1960's was the main factor contributing to increase in the caseload of pregnancy out of wedlock in the young teenage group. Among older teenagers (15–19 years), however, both the number of teenagers increased and also the rate for births out of wedlock. These changes are reflected in the larger number of out-of-wedlock pregnancies in need of care.

Dr. Wallace: I have a publication that contains data on trends in illegitimacy. One of the tables relates to the question that Dr. Kaiser raised. This table not only has numbers but illegitimacy rates per 1,000 women in specified age groups. The following are the data for the age group 15 to 19 years, showing the increase in rates as well as absolute numbers:

1940	7.4
1950	12.6
1960	15.3
1964	15.8
1965	16.7

So it is quite clear that in the 15 to 19 year age group, the reported illegitimacy rate has been going up.

Dr. Kaiser: The figures I have seen, which do not go through 1965, indicate that although the rate has increased in the 15- to 19-year-old population, it has increased less than for the country as a whole. The increase in rates, for example, in the 20 to 25 year group is much greater than the increase among adolescents and teenagers. Actually, then, the teenagers are not living up to what was expected of them. This would suggest a greatly improved rate of reporting during this time period.

Dr. Henderson: I reviewed the trends last year. It was my impression that among all social classes in this country, women are having their children earlier; therefore, the rates at the earlier ages are increasing. It appears that if you wait until the families are completed, there is no overall increase in total numbers of children; women are just having them earlier.

Dr. Kaiser: I wonder, Dr. Thompson, if the results in Grady Hospital in which prematurity stays steady, or doesn't drop, may be related to the steadily increasing proportion of women in the United States who deliver in hospitals. Perhaps 5 or 10 years ago, some of the people at very high risk did not come to the hospital at all and, therefore, were not included in your figures. Now, with the spread of prenatal care, we are getting more people into both the numerator and the denominator, and, since the risks are high, they are making our figures look worse, although we are, in fact, doing better. Is there any way of evaluating that?

Dr. Tompkins: There is one partial, presumptive piece of evidence. In many of our M & I clinics across the country, the prematurity rate has increased. This is favorable. It is in keeping with your suggestion, Dr. Kaiser, that the girls who have these prematures are now being brought under care. The significant payoff will come in subsequent obstetric experience as to whether or not the "project," or any care we give, is going to reduce prematurity, or other problems, that have been identified during the current pregnancy.

Dr. Jacobson: In the last 1½ years, I, along with some other people in this room, have been involved in workshops with the nutritionists in the M & I projects all around the country. What they point out uniformly is that they can make recommendations to people, but there is no way of guaranteeing that the people can execute them. Thus, there is no way of saying from the data that nutrition services are either good or bad when you cannot tell to what degree the people comply with the instructions.

This raises two additional areas which the Children's Bureau should seriously consider. Our students are not taught nutrition in medical schools as a major problem. In a practical sense, they are taught biochemistry, but they have little awareness of how people eat, how much food costs, and so on, because such matters are not a regular part of the curriculum. Secondly, the dietitians often come to the M & I projects with no background in maternal nutrition. Thus, there are three needs: the education of the physician, the education of the dietitian, and the need to develop a mechanism whereby people can get the food they require.

Dr. J. D. Thompson: Our hospital is responsible for the care of the indigent sick of two metropolitan counties. The number of home deliveries in these counties has been close to zero for some years. However, it is important to point out that our hospital sits at the intersection of five interstate highways, and these highways continue to reach out further in all directions. Therefore, it becomes consistently easier for a patient to get to our hospital when she is in labor. We do not turn away any patient who is pregnant and who needs our help. I wish I could say this for all hospitals in our country but, unfortunately, it's not possible. Because we have an M & I project, we are certain that we are delivering a large number of patients who live outside of our two-county area. These women are referred to our hospital by a public health nurse in another county where there are insufficient personnel and inadequate facilities. We also have patients who just come anyway.

Dr. Gold: The position speaker and the panelists this afternoon have touched upon and stressed many areas; they have especially underscored high risk factors. But I would like to see more emphasis placed on the responsibility and need for total interconceptional care.

Apparently, the interconceptional period between birth and the next pregnancy is growing shorter and shorter. As Dr. Tompkins said, we are now delivering 8- and 9-year-olds; according to Dr. Thompson, we have grand multiparas at the ages of 13, 14, and 15. Thus, one of the major responsibilities we have is to recommend to our Federal Government that M & I programs not only give maternity care to low-income women in our inner cities for the period of the pregnancy and the usual puerperal period of 6 months, but that we extend this care ad lib. This means that we should follow the mother and correct her medical, obstetric, emotional, and nutritional deficits well beyond the period of the current pregnancy. Also, we must either add a children and youth[*] program, or, within the concept of our own maternity and infant care programs, give care to the infants that we have delivered from these high risk patients, as well as render sibling care in the pediatric aspect of our programs.

Two additional areas of both service and research should be added; namely, some basic research on our high risk patients—specifically, tangible nutritional support. It's all well and good to do diet histories and have the nutritionist try to communicate within the language of the various groups we care for, but we have no definitive yardsticks by which we can measure the efficacy of such nutritional guidance, care, advice, and supplementation. It is time to begin to develop research along basic lines in the field of nutrition. I know of, but have not had the opportunity to explore further, what is known as a constellation test, or a battery of nutritional determinants which can be done in a laboratory on a single specimen of blood. But cost is the deterring factor at the present time, since in order to do 12 determinations on this blood specimen entails a cost of approximately $100 per patient. If this could be exploited and the cost brought down, this modality could be applied to antepartum and interconceptional care. We could apply—just as we now do a serologic test at the patient's first visit to our office or to the clinic—this constellation test for four amino acids, four vitamins, and four of the basic minerals, and then continue with our nutritional guidance, care, and supplementation. Then, at serial periods during the antepartum period, we could see whether or not what we are giving the patient is, in truth, the correct thing, or is being utilized, or is what the patient needs in order to improve quantitatively her nutritional status during the pregnancy.

I would recommend, therefore, that we have a broad expansion of our M & I programs to include ongoing care to the high risk mother beyond her pregnancy and through the interconceptional period. This care should be extended to the offspring we deliver in our M & I programs—in fact, to the

[*] Hereafter, may also be referred to as C & Y.

offspring ad infinitum. This would include care through infancy, childhood, and adolescence. If we are going to improve the quality of human reproduction, we would begin by improving the quality of our adolescents who, in increasing rates, as Drs. Wallace and Kaiser have pointed out, are becoming pregnant at the present time.

Dr. Terris: I would like to respond to the question raised by Dr. Kaiser. I believe it is correct to state that in the United States, the prematurity rate since 1950 has been rising for nonwhites and has been stationary for whites. This is the pattern in New York City and, I believe, for the country as a whole. The point has been made that a possible explanation is the increase in illegitimacy among the young. A more careful look reveals, however, that the rate for white infants born out of wedlock has gone up as much as for the nonwhite. Clearly, then, we have a difficulty—prematurity rates are going up for Negroes and not for whites, but the illegitimacy rates for young girls go up in both groups. This does not hang together.

We became interested in this peculiar problem of the rising prematurity rate among Negroes in New York City. We developed a hypothesis based on the importance of social class. The underlying reason for this problem, we hypothesized, must be the migration to New York City of Negroes from the rural South who end up in the poorest sections of the city. Therefore, the total socioeconomic level of the Negro population is depressed, and there is a higher proportion of very poor people. When we made the hypothesis, we had not looked at certain data. I think it is correct to state that in the United States, the prematurity rate, both for whites and Negroes, but more for Negroes, goes up with the size of the community. Actually, it is the cities that are causing the high prematurity rates; there is an association between the prematurity rate and the size of the community. The big cities, such as New York and Philadelphia, have the highest prematurity rates. If we had known this, we would not have adopted that hypothesis. We made our study, and I don't know how good our data are. If our hypothesis was correct, we would have expected to find a large proportion of new arrivals in the city among our mothers of prematures. It turned out to be the other way around: the mothers of prematures tended to be seasoned New Yorkers. This fits in with the idea that there is something about city life which is related to prematurity.

Dr. Stone: When I was a student, my pediatric colleagues blamed obstetricians and told the family that their baby was in trouble because of a bad delivery. But today, what I've heard is that obstetricians can say or do very little about the prevention of prematurity and its sequellae, since it's all socioeconomic or epidemiologic, and there is really no obstetrical responsibility that we can discuss and come to grips with. Still, from our own data, and from what Dr. Bishop reported, 8 percent of prematurity is iatrogenic. That's a solid, specific figure about which we *can* do something with solid, specific recommendations for improved maternity care.

Dr. Tompkins: I would like to ask one of the pediatricians to accept the responsibility of challenging obstetric care as to quality and methods.

Dr. Wasserman: I feel we pay a great deal of lip service to pediatricians and obstetricians working together. Dr. Gold indicated that the cycle of reproduction is never-ending and should be continuous. However, of the six people who spoke this afternoon in the formal program, not one is a pediatrician. This is typical of the type of lip service we pay to the cooperation supposedly existing between pediatrician and obstetrician. Dr. Brown commented that beginning at least with puberty, the primary physician for females should be the obstetrician. In some situations, the pediatrician might fit this role best; in others, the internist; and in others, the obstetrician-gynecologist. Yet I believe that when we begin to declare boundaries, we run into difficulty. This is best exemplified by the problem in the delivery room when a baby is born and is having difficulty. The pediatrician is called. The baby, perhaps, needs some resuscitation. Then the question comes up: who should perform this resuscitation—the anesthesiologist, the obstetrician, or the pediatrician? I think the answer should be that the one who is best prepared, or best qualified, should provide the care.

In the prevention of obstetric antecedents, one would have to define how far back antecedents should go and what they should include. For instance, what does the obstetrician tell the pregnant woman who is anemic as to why he is giving her iron? Does he ever include in this nutrition advice information concerning the results of iron deficiency in her infant? Shouldn't the pediatrician be included in planning for more up-to-date prenatal care? With the current state of knowledge, and because there is better cooperation between pediatrician and obstetrician, we could perhaps accomplish much along the lines that Dr. Stone recommended in trying to reduce prematurity based on known etiologic reasons.

Dr. Flowers: Dr. Stone is correct—there are many ways that we could improve obstetric care. We obstetricians are committing many errors. One of the sad facts is that the majority of obstetricians have no way of knowing when they deliver a child with cerebral palsy or one who is mentally retarded. The reason is that the mother of such a child generally takes him to a pediatrician or to some of the various centers that exist in her community. It is extremely important that a pilot project be initiated whereby, in a large community, every infant who is mentally retarded or develops cerebral palsy is reported by the various physicians or centers that see this infant. Then a carefully constructed and well-defined epidemiologic study would be conducted. This would reveal much that obstetricians are doing; for example, that they are inducing labor. I do not know how this can be prevented. The mothers want it, and the obstetricians essentially consider this to be the mothers' prerogative. By and large, this is done in hospitals as follows: The patient is brought in on a specific date. Many times, insufficient thought and care have been given as to whether the patient really has obstetric complications or whether she is at term. Pitocin is given without the obstetrician being present. Often a licensed vocational nurse (or people with even less ability) supervises this pitocin stimulation. The obstetrician is called at the time the anesthesiologist has paralyzed the mother, and delivery occurs.

We need to develop early warning systems in the induction of labor, both indicated and elective. These early warning systems are available to us. If we can determine the blood pressure, heart rate, and the EKG of a man going around in space at the rate of 17,000 miles per hour 150 miles above the earth, certainly we can develop early warning systems whereby we will know if there are irregularities in fetal heart and a development of a fetal heart pattern which indicates fetal distress. Certainly, we ought to be able to monitor through early warning systems the development of excessive intrauterine pressures secondary to labor If we can do this, we will have gone a long way toward making obstetrics safer.

It is very important, therefore, that we: (1) develop a reporting system and epidemiological studies to determine obstetric problems which are created by obstetricians and which can be prevented by better care, and (2) develop early warning systems, both in normal labor and, particularly, in induced labor.

In regard to food and nutrition, it is fundamental that some studies be made. Nutrition is important—but, until we set up a study that proves this, we will not be able to initiate a sufficient amount of mobility and thrust in governmental agencies regarding this critical area.

Dr. Wallace: I would like to go back to a previous topic and ask: how does all of this appear to the pediatricians? Certainly, the 9 months of pregnancy are much too brief a period in which to accomplish what should have been done previously. Thus, the need exists for longitudinal care for girls, beginning with infancy and continuing through the preschool period, through childhood, adolescence, and adulthood, along with care for their mates, and there should be some emphasis on nutrition.

I would like to cite some well-known information concerning the health status of children and youth of low-income families. (This information comes out of our antipoverty programs, such as Head Start, the Neighborhood Youth Corps, Job Corps, etc.) The children and youth of low-income families have the health problems that children in our country generally have, but they have them in greater frequency and with greater severity. One of their most frequent health problems is anemia. So, let me repeat: we pediatricians have a far greater responsibility in trying to be of assistance in bringing girls up to optimal health a long time before pregnancy is ever a possibility.

Dr. Tompkins: I would like to ask Dr. Felton, who is a pediatrician and the Regional Medical Director for the Children's Bureau in the New York office, to comment at this time.

Dr. Felton: For many years, I have worked closely and productively with a number of obstetricians. I have learned at first hand how difficult it is for both the pediatrician and the obstetrician to relinquish to each other the task of "taking over." This involves basic personality; it involves the uncertainties and frustrations of crises; and, in the end, it can only be resolved by learning to know very well the person with whom you are working. This cannot be regulated by books and rules and regulations. This must be acquired by the mutual respect of one discipline for the other. We see this same principle now as we develop working relationships in our comprehensive programs with other than medical professionals.

It is heartening to me to see that in an extremely short period of time, in some instances less than 2 years, the physicians in charge of some of our comprehensive care programs—not only the C & Y programs but also the M & I—have established a satisfactory relationship with the other people with whom they are working. We can see the earning of the mutual respect of one discipline for another. This development is a fundamental facet in improving the health of all of our children, as well as the mothers.

Dr. Gold: I want to thank all of the participants for an instructive, informative opening day for the Conference.

SESSION III

Prevention of Premature Labor

Session Chairman: RALPH C. BENSON, M.D.

OPENING REMARKS

Dr. Gold: I would like to briefly summarize the extensive material covered during our discussions in Sessions I and II.

We certainly spelled out the etiological factors. We came to a reasonable agreement that a reclassification was in order in relation to the low birth weight infant, and, to that end, our ad hoc committee will have a report for us. There was reasonable agreement on the identification of the high risk factors in relation to low birth weight. Reasonable acquiescence was reached concerning the areas involved with service. We felt that adequate care of the patient required redefinition and, to that end, recommendations and suggestions were made: first, that we should tailor-make our procedures for specific high risk categories of patients and, second, that we should improve obstetric practice, particularly toward elimination of the iatrogenic factors productive of premature delivery.

We had a look into the future with regard to manpower projections in relation to a projected increase in births to about 5.3 million in 1980. To that end, the projection was made for increasing our technical manpower from a current 16,000 obstetricians to about 27,000 and, for pediatricians, from the current 15,000 to approximately 20,000.

Reasonable agreement and consensus were reached concerning not only the expansion but the extension of maternity and infant care and children and youth care. The pervading theme in this seemed to be related to the program of continuity as exemplified in interconceptional care with particular stress on adolescents as a group and on the modality of the use of homemaker services in relation to maternity and infant care.

In our projections for the future, it was the consensus of the group that there be an expansion of intensive care services, not only in the labor and delivery suite—and, in that area, the addition of biomedical monitoring facilities and expansion of research along that line—but also that intensive care services to the neonate be expanded. The role of family planning, abortion, and sterilization as part of a total reproductive care program was likewise injected into the discussion. A certain consensus was reached in regard to the discussion on research needs. We felt from what we had heard and digested that low birth weight may not be the sole factor in the production of mental retardation and that we should intensify research in the area of how congenital malformations relate to low birth weight infants.

We had reasonable consensus on the need for nutritional research, particularly the quantitating of our information with regard to nutrition needs, and the relationship of nutritional deficits and programs to eradicate these deficits, not only during the pregnancy but particularly in the period antedating the pregnancy.

We also felt that we were in an era where we should proceed to expand sociocultural and motivational research in order to develop better communication and to better implement our program of total care. In that same area, we felt there was a need for more quantitative means of evaluation, not only of studies but also of our service operations; also that we should attempt to develop control studies rather than the observational type of data being used at the present time. In this context, we need to evaluate the type as well as quality of care being rendered in our programs today.

At this point, I want to say that there seems to be some indecision or some question as to where we go from here in our M & I and C & Y programs from the point of view of financing. We are in a precarious position because of what is happening to the dollar. I would like to ask Dr. Tompkins if he would tell us what the situation is regarding the future financing of our programs.

Dr. Tompkins: There seems to be some misunderstanding about the Children's Bureau's M & I programs. The intent of these programs, although they are properly called service programs, are, in a sense, demonstration programs. Unless it can be demonstrated that this type of program leads to an improved outcome of pregnancy, I have some doubts as to how much funding eventually will be made available. To make a significant impression on Congress, it must be demonstrated that this type of approach can make an impact.

There is a feeling and it was expressed several times yesterday, that the deficit is that we need money to cover everything for all people for all things. This is unrealistic. It is important to clarify several areas. It is true, and I think all of us will agree, that it would be highly desirable if we had sufficient funding so that all poor people in our country could be covered; however, presently this is impractical. It should be understood that M & I and C & Y programs are intended to bring additional funds to a specified area of major concentration of people of low income, particularly our cities and counties contributing to excess infant mortality. They are intended to determine if a comprehensive multidisciplined approach (which has been lacking) can make a significant impact in reducing several serious problems, one of which we are here to discuss specifically. There has been a misunderstanding as to the high risk category; these projects are concerned with *all* patients. In the areas eligible for project coverage, high risk comes into the picture only to the extent that if a high risk condition is identified, project funds may be used to cover inpatient hospital care if other funds are not available.

I think we have a very significant amount of money available; we have a reasonable amount of manpower; we have very good facilities. Every effort should be made to revise our approach to the problem on the basis of what we presently have available and can reasonably expect to have available in the next 5 to 10 years.

One other point. Inpatient care is minimally acceptable in almost all of our so-called accredited or reasonably good clinical centers. However, the primary area of deficit is in outpatient antenatal and postnatal care. This

Conference must address itself to this particular segment of the problem. We have funds for personnel and services that can help in this area. If we do not begin to resolve this problem at this Conference, we will be back at a conference such as this every year for the next 20 years.

DR. BENSON: Our subject for this Session is "Prevention of Premature Labor." I will keep my comments until after the panel discussion.

PREVENTION OF PREMATURE LABOR

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Obstetricians, both clinical and research, have no greater challenge than attaining the solution to the problem of premature labor. Both the importance and the urgency of this subject are accentuated by two factors. First is the realization that prematurity is responsible for a greater number of fetal and neonatal losses than the aggregate losses associated with all other complications of pregnancy. A second indication for concentration of effort in this area is the appalling cost to society for the support and care of those surviving premature infants who are often deficient in mental and physical development. As shown in Figure 1, the incidence of neurologic and psychologic abnormalities occurring during the first year of life is four times as high for the smaller prematures as it is for the full-term infants.

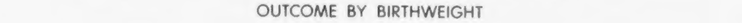


Figure 1

Premature labor occurs so frequently, and results from one or more of such a conglomeration of often unrecognizable etiologic factors, that, until recent years, the occurrence of the complication was usually accepted as unavoidable or inevitable. Today, the clinician not only can but is obliged to do something about this problem. We suggest that this can be accomplished by stimulation of interest and by use of the tools now available to us all. The results of such an assault are shown in Figure 2, comparing, during a 12-year

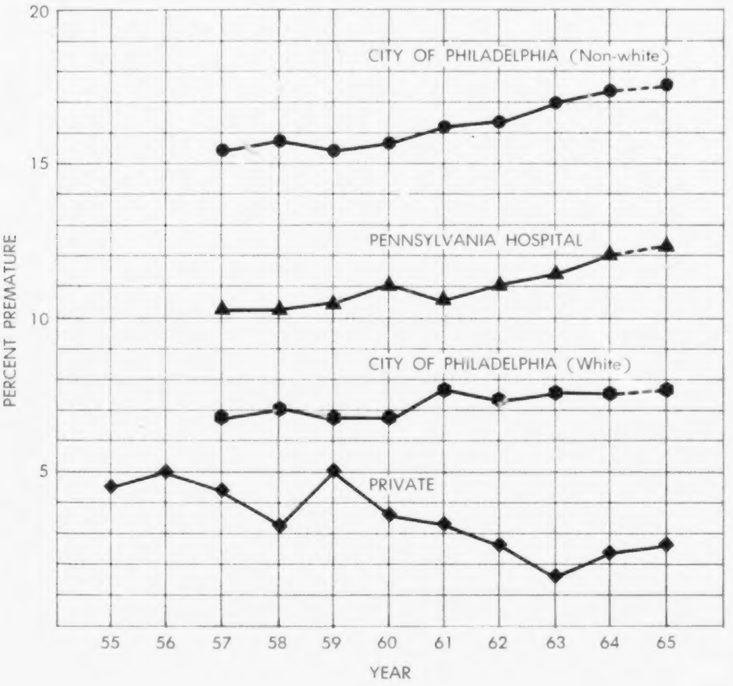


FIGURE 2

period, the incidence of prematurity in the City of Philadelphia, at the Pennsylvania Hospital, and in the practice of selected individuals who directed their efforts toward the alleviation of this problem. Certain conclusions are obvious from this illustration. First is the higher rate of prematurity among the nonwhite compared to the white section of the population. Next is the higher rate among the general hospital population compared to the study group in the same institution. These differences are, of course, related to variations in the types of population comprising the different groups. More important, however, is the fact that instead of the sought-for reduction in the incidence of prematurity in the City of Philadelphia and Pennsylvania Hospital groups, there has been, instead, a trend toward an increase. This rising trend is undoubtedly a result of a change in the type of population occurring during the years under consideration.

By contrast, we were able to demonstrate a 50 percent reduction in the incidence of prematurity in a study group which has remained constant in character. This reduction was accomplished by a triple offensive comprised of a regimen of prophylaxis, including careful management of prenatal and intrapartum complications, early recognition of the high risk patient, and institution of active therapy directed toward inhibition of premature uterine contractions.

Prophylaxis

Many factors under this heading have been mentioned previously in this Conference but deserve repetition for the sake of emphasis.

1. *Improvement of the social, economic, and educational status of the mother.* The highest premature rate occurs among that section of the population which is underprivileged economically, socially, educationally, and ethnically. This unfortunate combination of circumstances results not only in poor physical status, careless reproductive habits, and poor nutritional states, but develops and fosters a lack of personal responsibility to acquire adequate medical care at the ideal time. Society as a whole, rather than the medical profession alone, is responsible for improvement of certain of these undesirable circumstances. A radical alteration in our social structure may be necessary to eliminate certain predisposing factors, but if the obstetric discipline hopes to prevent premature labor, the clinician must obtain better material with which to deal. We do, however, have an obligation to stress the effect of these various influences on reproductive outcome.

2. *Improvement of prenatal care.* We cannot escape our responsibility to give the best care possible to that material with which we must cope at the present time. Too often, prenatal care is relegated to the least skilled and to the least experienced of our profession. Too often, prenatal care is considered a boring, routine necessity. Only the traditional high spots are covered, without either adequate indoctrination or observation of the patient. Dietary instruction is often sketchy, psychological preparation for pregnancy is lacking, adequate instruction is seldom given, and personal attention is absent in the factory-like production line of the typical prenatal clinic. Regrettably, this description may be applied to the private office practices of some busy obstetricians. A new definition of "adequate" prenatal care must be developed, and its practice must be essential.

3. *Improvement in the management of those prenatal and intrapartum complications which are associated with a high rate of prematurity.* Time and space permit only a few examples of the situations falling into this category. Emphasis should be placed on the early recognition and vigorous treatment of the actual or potential toxemic patient in order to permit continuation of pregnancy without interruption as close to term as possible. Simultaneous and cooperative care of the diabetic by both the obstetrician and the internist is essential in the management of this complication. The decision regarding the optimum time for delivery must be determined by the medical status, the course of pregnancy, and estimations of placental function, rather than by the arbitrary choice of an early delivery date. By the utilization of serial estriol determinations and, if indicated, by the institution of decreased activity up to complete bed rest, it is possible to continue the pregnancy of many diabetic or toxemic mothers closer to term and avoid the premature delivery of a metabolically immature infant.

The obstetrician must always be alert to the possibilty of cervical incompetence and eliminate this complication by repeated examinations of the cervix during pregnancy.

The proper time for delivery of the Rh affected fetus must be determined by the results of spectrophotometric examinations of the amniotic fluid rather than subjecting the fetus to a premature delivery indicated by history or abnormal titers alone.

Fear of the possibility of a subsequent lethal reoccurrence of an obstetric hemorrhage may prompt the obstetrician to terminate pregnancy prematurely while, instead, gestation may be prolonged by continuous hospitalization and observation of the mother.

These represent a few examples of the many instances in which the obstetrician may reduce the extent of prematurity by more thoughtful care and more modern management. When the early termination of pregnancy is essential and a question exists regarding the stage of fetal maturity, we have found cytological examination of the amniotic fluid to be a more accurate index of fetal development than history, physical estimation of fetal size, or radiographic examination. This test is based on determination of the percentage of lipid-containing cells in the cell population of the amniotic fluid. As shown in Figure 3, the percentage of "fat" cells increases with increasing fetal maturity.

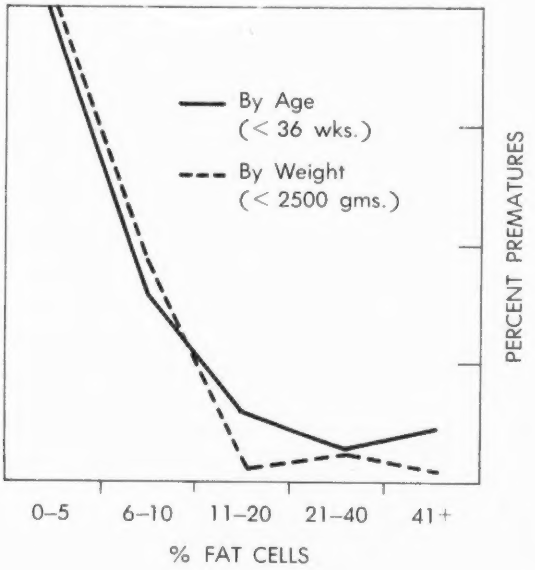


FIGURE 3

Two iatrogenic causes of prematurity are inexcusable: elective induction of labor, and elective cesarean section. In our institution, 6 percent of all premature infants were a result of one of these two situations. In other areas, even higher rates have been reported.

The optimum time for an elective induction of labor must be determined by evaluation of those cervical changes which presage the spontaneous onset of labor rather than by calendar date or estimation of fetal size. In the same fashion, one may determine the most suitable time for performance of a repeat or elective cesarean section. When either the expected date of delivery and/or the fetal size is questionable, there is little disadvantage of waiting for the pregnancy to continue to or past term, or even of waiting until the spontaneous onset of labor before the performance of a repeat cesarean section. Convenience of the physician, the patient, or the hospital is a poor justification for the inadvertent delivery of a premature infant. Under these circumstances also, cytologic examination of the amniotic fluid obtained by transabdominal amniocentesis or observation of the prelabor cervical changes are both less hazardous procedures than the unjustified delivery of a premature infant.

The present furor regarding the urgency for delivery of all patients within a specified number of hours after premature rupture of the membranes has some justification, but this practice has increased our rate of prematurity. Occasionally, the diagnosis of ruptured membranes has proven erroneous and interference was not indicated. After 36 weeks' gestation, prompt evacuation of the uterus because of premature rupture of the membranes is probably justifiable; but at earlier periods, the risk of immaturity must be balanced against the chances of intra-amniotic infection. It is possible to allow some fetuses to remain in the uterine cavity to attain increased maturity and improved salvage.

Early Recognition of the High Risk Patient

While not directly responsible for the onset of premature labor, there are numerous associations which can alert the obstetrician to an increased chance of prematurity.

1. *Race.* This association needs no further discussion.
2. *Age of mother.* The incidence of prematurity among various age groups is shown in Table 1. Prematurity rates are higher at both extremes of the childbearing period. This relationship remains constant even when controlled by other variables.

TABLE 1.—*Relationship of prematurity to age of mother*

Age (Years)	*Incidence of prematurity* (Percent)
Less than 15	14.3
15–19	17.0
20–24	7.9
25–29	7.4
30–34	8.0
35–39	9.1
40–44	12.4
45 or older	18.7

3. *Maternal hemoglobin value.* The most constant and marked relationship noted in our study of the factors influencing the incidence of prematurity was concerned with the maternal hemoglobin level at the time of the initial prenatal examination (Table 2). Undoubtedly, this value is merely an easily demonstrated reflection of the mother's nutritional status. Once the patient presents herself for prenatal care, not enough time remains before delivery for full correction of nutritional deficits, but, as demonstrated by Tompkins (Table 3), intensive therapy can reduce the anticipated incidence of prematurity.

TABLE 2.—*Relationship of prematurity to maternal hemoglobin levels*

Maternal hemoglobin value (Grams per 100 ml.)	*Incidence of prematurity* (percent)
Less than 5.9	37.2
6–6.9	14.2
7–7.9	13.8
8–8.9	13.6
9–9.9	12.4
10–10.9	12.8
11 or more	8.2

TABLE 3.—*Incidence of prematurity related to nutrition*

Pregravid weight	*Incidence of premature labor*	
Overweight to 5%	Control	6.3%
Underweight	Therapy	5.0%
More than 5%	Control	22.8%
Underweight	Therapy	8.9%

4. *Time between pregnancies.* We were able to demonstrate a significant relationship between the incidence of prematurity and the spacing of pregnancies (Table 4). When a pregnancy closely succeeded a previous one, the rate of prematurity was more than doubled.

TABLE 4.—*Relationship of prematurity to the time between pregnancies*

Interval since previous pregnancy	*Incidence of prematurity* (percent)
No previous pregnancy	11.4
More than 23 months	7.8
12 to 23 months	10.3
Less than 12 months	18.0

5. *History of premature delivery.* Whatever the factors that cause prematurity, they appear to be permanent and repetitive (Table 5). Statistically, a woman who has not had a premature baby has an 8 percent chance of experiencing a premature labor. At the other extreme, a mother who has had three premature infants has a 50 percent chance of delivering a subsequent infant prematurely.

TABLE 5.—*Relationship of prematurity to previous premature deliveries*

Number of previous premature deliveries	*Incidence of prematurity (percent)*
0	8.3
1	19.9
2	28.7
3	45.5

6. *Maternal heart size.* Even if one corrects all of the aforementioned situations, there still remains a vast number of premature labors which occur unexpectedly without recognizable etiology. It begins to appear that many of these may be on a circulatory basis. It is an established fact that those mothers with an increased workload relative to their physical status have an increased chance of prematurity. Bruns and Taylor reported that patients exhibiting a decreased clearance time of a radioactive isotope from the myometrium could expect an increased chance of premature labor. They postulated that this reflected decreased uterine blood flow. Raiha, Unnérus, and Bishop have independently reported that patients with a decreased heart size during pregnancy also have an increased chance for a premature delivery.

The relationship between variations in cardiac volume and incidence of prematurity in patients of comparable age, race, height, weight, and other essential characteristics, is shown in Table 6, demonstrating a linear inverse relationship between maternal heart size and rate of prematurity. The small heart, probably associated with decreased cardiac output, and a possible reduction of uterine blood flow, may result in a relative uterine hypoxia and myometrial irritability with the subsequent onset of premature labor.

TABLE 6.—*Relationship of maternal cardiac volume and incidence of prematurity*

Heart volume	*Percent premature*
340 or less	20.0
350–440	24.0
450–540	13.0
550–640	5.0
650–740	5.0
750 or more	1.5

In spite of certain divergent reports, we remain impressed that cardiac volume is an easily measured parameter which may alert the obstetrician to a potentially high risk pregnancy. Both cost and potential radiation hazards have deterred further investigation of this hypothesis, but both of these deterrents may be avoided by ultrasonic rather than radiologic determination of cardiac volume.

It has been our experience, as well as that of others, that reduction of the workload of patients with smaller than normal heart sizes will drastically reduce the anticipated high risk for prematurity.

Inhibition of Premature Labor

Even when all of the recognizable precursors of premature labor are recognized and corrected, a large number of early labors still occur which cannot be anticipated or prevented. Under these circumstances, the only alternative remaining is to attempt the arrest of premature uterine contractions. Neither sedative drugs nor hormonal preparations have demonstrated any real value for this purpose. Claims for success for these methods of therapy are undoubtedly the result of the decreased activity and bed rest which are usually simultaneously prescribed. This beneficial effect of bed rest cannot be overlooked and is probably the best single agent in our armamentarium.

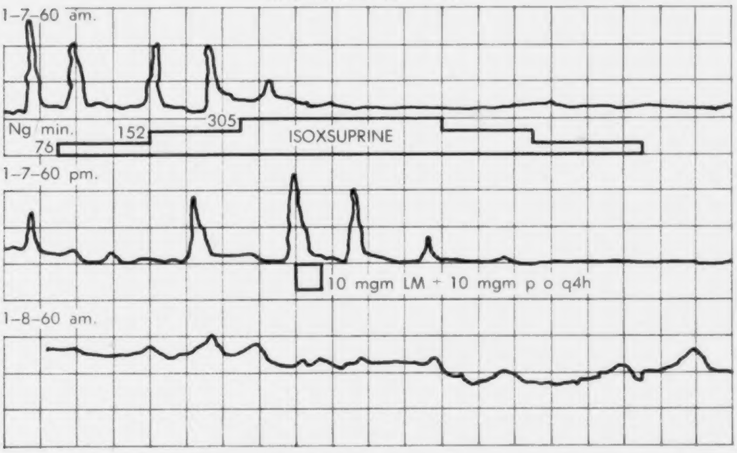
The use of isoxsuprine, a beta-adrenergic agent, was used in our initial attempts to arrest premature labor. Previous laboratory and animal experimentation had shown that this drug had the ability to relax smooth muscle, particularly of blood vessels and of the myometrium. Initial attempts were made, without success, to alter the pattern, frequency, or intensity of the contractions of full-term labor This was true even when the drug was administered at a rate and quantity large enough to result in alterations of the maternal pulse and blood pressure. Fortunately, it was later observed that the uterine activity of premature labor must differ from that occurring at term, since the administration of isoxsuprine to patients in early labor resulted, in almost all instances, in a prompt diminution of both frequency and intensity of contractions. The best results occurred when the membranes were intact and the cervix was less than 4 cm. dilated (Figure 4).

Intravenous administration of 20 milligrams of isoxsuprine followed by intramuscular injection resulted in temporary or permanent cessation of uterine contractions in a significant number of instances (Table 7). Even if premature labor recurred, a worthwhile result had been accomplished by increasing the period that the fetus would remain in the uterus, thus reducing the anticipated high risk of perinatal mortality. By experience, it was concluded that the optimum safe but still effective intravenous dose was 400 micrograms per minute until a total of 20 milligrams had been given. Subsequent medication was given either intramuscularly or orally. If uterine contractions did not diminish or cease with the inital 20 mlligrams, subsequent medication served little purpose.

The only undesirable side effects observed were maternal tachycardia and hypotension. Usually, the patients complained of restlessness or appre-

Effect of isoxsuprine on uterine contractions of patients in premature labor.

MYOMETRIAL RELAXANT



PREMATURE LABOR AT 32 WEEKS

FIGURE 4

hension before alterations of the vital signs became obvious. All abnormal maternal vital signs promptly returned to normal after cessation of administration of the drug. An occasional fetus had a mild bradycardia but this, too, returned to normal if the drug was stopped. No surviving infants have shown any evidence of harm from the drug.

TABLE 7.—*Results of Isoxsuprine Therapy*

Group	*No.*	*Percent*
Labor not arrested	36	36.0
Labor arrested 1–7 days	12	12.0
Labor arrested more than 7 days, premature infant	8	8.0
Labor arrested, mature infant	44	44.0
Total	100	100.0

The obvious fault in these seemingly favorable results is the absence of a control study by us or by others. While definite effects following the administration of isoxsuprine have been demonstrated in the laboratory, and specific effects have been shown clinically, it is impossible to discount the effect of the bed rest which is instituted concomitantly with the administration of the drug. Even after labor stops, the threat of the previous premature labor usually prompts the patient to either consciously or subconsciously decrease her subsequent activities. While apparently the drug has a direct effect upon the myometrium, its action as a vasodilator, combined with the decreased workload, may relieve the uterine hypoxia and decrease the myometrial irritability. Unfortunately, and apparently with reason, this method of therapy still remains an investigative or research method, since the Food and Drug Administration has not released this item for general intravenous use.

Fuchs has reported that the intravenous administration of ethyl alcohol has an inhibitory effect on uterine activity of early labor. It is claimed that this prevents activating stimuli from reaching the myometrium by inhibiting the release of oxytocin from the neurohypophysis. The results reported by Fuchs are strikingly similar to those reported after the administration of isoxsuprine. It is possible that the similarity of results is due to a similarity of action, namely an increase in uterine blood flow brought about by inactivity and by the use of a vasodilator. Here again, results cannot be scientifically evaluated without the performance of a control study.

More recently, we have had the opportunity to investigate the action of another drug which has a marked effect upon myometrial activity—methanesulfonamide. When investigated in the laboratory, this drug exhibited 10 to 40 times the myometrial relaxant ability of isoxsuprine. At equipotent uterine relaxant doses, the cardiovascular action was less intense than with isoxsuprine. Our clinical experience with this drug has been limited but confirms the predictions based on laboratory and animal experimentations. Unlike isoxsuprine, methanesulfonamide has a definite and predictive depressant effect upon the contractions of labor occurring at term. When used on 36 occasions at various stages of gestation, previously well-established uterine contractions ceased in 26 instances. The effect on five patients was questionable and, in another five instances, no effects could be observed. Occasionally, alterations in fetal pulse, maternal pulse, and maternal blood pressure occurred but promptly returned to normal when administration of the drug was discontinued. Conservative concern with both fetal and maternal safety has resulted in discontinuation of further investigation of the product which may not only be a valuable addition to the armamentarium of the obstetrician but a life-saving drug.

Three approaches directed toward the prevention of premature labor have been presented. Drug inhibition of uterine contractions is symptomatic and empirical therapy reserved for the failure of preventive measures. Nevertheless, until we know more about the etiology of this serious complication of obstetrics, arrest of labor serves a useful and valuable purpose in a significant number of instances. Early recognition and therapy of those obstetric complications associated with or resulting in prematurity are essential. Most important of all is the practice of adequate prophylactic measures—an obligation that is not only a medical, but an economic and social problem of our society.

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PANEL DISCUSSION

RESPONSE

by

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For a pathologist, it is difficult indeed to open the discussion on Dr. Bishop's excellent paper in which some results are reported of experimental trials aimed at the reduction of prematurity and the deferment of premature labor. I have intentionally separated these two topics, for it seems to me that Dr. Bishop reports, on the one hand, the Philadelphia experience with premature births in general, and then proceeds to describe trials to arrest premature labor by medication. And these two topics, while related, are not necessarily identical.

I feel no one here can argue with his opening statement that "Obstetricians . . . have no greater challenge than attaining the solution to the problem of premature labor." At the same time, the complexity of the task is enormous and perhaps would be quantitatively achieved most readily if the social environment of the high risk patient improved more uniformly and quickly, as the author also suggests. The complexity is enormous, for, as Dr. Bishop points out, the accepted or suspected antecedent culprits to premature birth are varied and not fully understood. In fact, as a pathologist who only sees the fatal ends of this picture, I am impressed by the nonuniformity of these fatalities, which suggests that simply retarding labor may not be the optimal choice of therapy for this condition; rather, it would seem that prevention is the ultimate goal.

In an admirable review on the "Pathogenesis and Prognosis of Prematurity," Abramowicz and Kass have recently analyzed critically the major components as they are now recognized. The reason why so much divergence of opinion still exists concerning such seemingly easily analyzed conditions as heart size, hemoglobin concentration, and smoking is, these authors conclude, the enormous number of variables one must consider when attempting a prospective study with an adequate control population. To some extent, this has been overcome in the study of which we have just heard. The reduction in prematurity rates on the private service from 5 to 2.5 percent over 10 years is highly commendable. However, which component of this better prenatal care given this sector improved the rate over the general 10–12 percent rate at the same hospital remains elusive. If it is simply recognition of high risk patients and better care (such as hospitalization, vitamins, nutrition, relief from work) after such recognition, then these should be singled out and corrected. Reports from other clinics, however, suggest that many more complex social factors may underlie these differences. Special care for high risk pregnancies is surely in the center of attention currently and, to some extent, amply justified by the results of some special clinics; for instance, the meticulous supervision in diabetic populations.

One aspect of the preceding paper considerably disturbed me since, being primarily an educator, curricular changes are often discussed among my colleagues. Dr. Bishop suggests that an important difference in care may be in part responsible for the differences observed in premature rates in the private vs. the clinic sector. "Too often, prenatal care is relegated to the least skilled and least experienced of our profession"—a statement which reminds one of the fact that, in my profession in the past also, the assignment of autopsies of different aged bodies paralleled the experience of the prosector. Hence, pediatric and particularly perinatal pathology had a late blooming. This is no longer the case, and the meticulous inquiry of the cause of death of a premature is now as great a challenge to us as that of the complications following cardiac surgery. If lack of experience and skill are important factors in prenatal clinics, then we should alert those responsible for today's curriculum to this fact. Rather than deleting portions of obstetrical teaching or even making it elective, perhaps it should be changed drastically to concern itself primarily with the pathophysiology of pregnancy rather than delivery. I am aware that some of this is attempted in some schools, but possibly more can be done at this end than is undertaken now.

The other speakers will presumably direct their attention more toward the results of medical treatment of premature labor which have been discussed by Dr. Bishop. For me, it is more appropriate to speak briefly about the possible prevention of aspects of intrapartum or prepartum complications.

As has been stated previously, the cause of prematurity is a conglomerate of many conditions—some recognized, some disputed, and some only suspected. It is perhaps important to emphasize again that, while any one of these factors individually accounts for only a small percentage of prematures, in aggregate they amount to a sizable number which, if prevented alone, would make for a more salutory outcome. Clearly, then, it is inexcusable that 10 to 15 percent of prematures in some institutions should be sequel of elective induction or section, and Dr. Bishop is to be congratulated that only 6 percent of his series is so composed. Needless to say, improved diagnostic tools such as ultrasound will play an important role in preventing this outcome in the future, but perhaps most important here are education and vigilance by the obstetrician. As a pathologist, I cannot help but feel badly when I find only hyaline membrane disease in an otherwise normal infant born after elective induction. Similarly, toxemia and diabetes, while alone perhaps insignificant numerically, help in pushing up the aggregate. Despite much discussion, even criticism, of estriol determinations during pregnancy, I believe that they offer a better means of surveillance of the last weeks of these high risk pregnancies than other methods employed heretofore. The necessity for repeat examinations, beginning prior to deterioration of the fetus, has been emphasized. Perhaps wider usage and evaluation of this relatively simple technique in high risk pregnancies should be considered. Further, it may be necessary for this group also to consider the recommendation to implement rapidly and widely the newly available possibility of preventing most rhesus-factor sensitization after pregnancy with hyperimmune serum.

Another substantial cause of prematurity, and particularly of mortality, has not been touched upon: the multiple pregnancy. It is well appreciated now that single ovum twins fare much poorer than their fraternal counterparts, and their inclusion in the high risk group, with special care, bed rest, expert supervision of delivery, etc., seems obvious. Perhaps more than in other groups, amnioscopy is indicated because of the higher frequency of vasa praevia, meconium discharge, and hydramnios.

There is one final aspect which is of considerable interest to the pathologist and to which Dr. Bishop has only referred tangentially, namely the relationship of prematurity to infection. Rightly, he has referred to the furor (I think he means the literature) concerning the urgency of delivery within a specified number of hours after premature rupture of the membranes in order to avoid ascending infection. This certainly has added to the incidence of prematurity, and it is difficult to obtain a clear picture from the vast number of papers in the literature on how to proceed.

Studies which support, and others which deny, early delivery of premature babies under such circumstances are easily cited, with most authors agreeing that delivery should proceed promptly near term. The reason why this is of greater interest to the pathologist is that he so often finds an inflammatory exudate in the lungs and placentas of particularly the younger prematures at autopsy. From an analysis of our findings at the Boston Lying-In Hospital some years ago, we have come to *this* conclusion and see no reason to change our views following the publication of different hypotheses in recent years: simply stated, it might be said that ascending infection is often a cause rather than a sequel of premature labor and rupture of the membranes. Furthermore, it often recurs in the same patient and, from this point of view, the high recurrence rate of premature births, which Dr. Bishop presented in his Table 5 (page 119), is of great interest. Inflammation of the placenta is a very frequent finding at term and more so in premature deliveries. The inflammation connotes, we think, the response to infection, and, because of the time intervals concerned, this infection may well have been the primary agent weakening membranes of these infants. By all tests performed, normal premature membranes have a higher tensile strength than those at term. The recurrent finding of chorioamnionitis and, at autopsy, pus in the lungs of the infants of many well-supervised patients, pregnancy after pregnancy, and in the absence of recognizable premature dilatation of the cervix, or even after surgery for such a suspected condition, must be recognized in the context of this meeting. Certainly, adequate examination of the placentas and autopsy data should be a necessity in studies designed to ascertain the etiologic mechanisms of prematurity. It is unnecessary to point out also that the sporadic contribution of congenital anomalies would otherwise not be appreciated.

In this area, I believe the most important contribution has recently been made by the isolation of mycoplasmas from such affected pregnancies by Kundsin, Driscoll, and Ming (*Science* 157:1573, 1967). This report describes their isolation from premature infants and placentas showing the conventional "amniotic sac infection syndrome" which is so extremely common but in which bacteria are only uncommonly isolated. Not only were these agents cultured from the products of conception but also, postnatally, from cervix and from the husband. Considering the frequency and importance of this syndrome for premature delivery, particularly for recurrent prematurity, this finding has opened a new field for inquiry and treatment since these organisms, once identified, are sensitive to therapy. As with the still controversial contribution of bacteriuria, my recommendation would be to place identification and therapy with appropriate controls on the agenda of obstetrical clinics dealing with such problems.

RESPONSE

by

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Prevention and Inhibition of Premature Labor

Prematurity remains by far the most important cause of neonatal death, and progress in the prevention of premature delivery has been very slow. In New York City, with a population of 7.84 million, 10.1 percent of the live births in 1964 resulted in infants weighing under 2,501 grams. The mortality during the first 7 days of life was 14 percent in this group, as compared with 0.4 percent in those born with a birth weight of 2,501 grams and over. Or, to express it in a different way, 78 percent of the neonatal mortality occurred in the premature group.

Perhaps even more important than the high mortality is the high morbidity due to prematurity. If we could prevent premature labor by prophylactic measures or arrest premature labor by inhibition of uterine contractions, half the battle against mental retardation would be won.

Dr. Bishop has reviewed the possibilities for prevention and inhibition of premature labor in a comprehensive fashion that leaves almost no room for contradiction and only little for amplification. At the New York Hospital, we are currently evaluating the relationship between maternal heart volume and length of pregnancy. We are convinced that there is a relationship between small maternal hearts and the incidence of prematurity, but, before we can decide whether it is a direct cause-effect relationship, other parameters of cardiovascular function, such as peripheral blood flow, will have to be studied. Should anyone remain in doubt about the relationship between small maternal hearts and prematurity, the recent thesis of Kauppinen from the Health Department of Helsinki (1967) must convince him (Table 1). If mothers with small hearts are not working during pregnancy, the risk of prematurity is less than half of the risk in working mothers. Highly significant as they are, Kauppinen's figures also indicate, to me at least, that cardiovascular factors are not the only causes of prematurity.

The treatment of threatened premature labor with alcohol has received a great deal of attention recently. Dr. Bishop is absolutely correct in pointing out that controlled studies are imperative. We hope to be able to present such studies in the future, but for the time being I can only show our figures as of July 1967. Since our report last year (Fuchs et al., 1967), we have stopped giving alcohol to patients with ruptured membranes.

TABLE 1.—*Frequency of premature birth in working mothers and housewives according to maternal relative heart volume* (Kauppinen, 1967)

Relative heart volume	*All mothers*	*Premature births—%*	*Working mothers*	*Premature births—%*	*House-wives*	*Premature births—%*
Small ≤ 380 cc/sq.m	1,917	6.7	1,411	7.7	506	4.3
Medium 385–450 cc/sq.m	10,040	4.3	7,276	4.4	2,764	3.9
Large > 450 cc/sq.m	2,749	3.6	1,958	3.9	791	2.9
Not examined	4,599	5.9	3,238	6.4	1,361	4.9
Total	19,305	4.8	13,883	5.1	5,422	4.1

The material comprises 81 patients, including 6 with twin pregnancies. The present dosage of alcohol is as follows: 100 ml. of 95% alcohol is mixed with 900 ml. of 5% dextrose in water to give a 9.5% (v/v) solution, containing 75.4 g. alcohol per liter. The initial dose is 15 ml. per kg. body weight given intravenously over 2 hours. The alcohol concentration in the blood at the end of the "loading" period is 0.12–0.18%. This concentration is then maintained by infusion of one-tenth of the initial dose, or 1.5 ml./kg., per hour. In about 12 percent of the cases, more than one course has been given.

The effect of alcohol on threatened premature labor has been evaluated by the initial effect on the uterine contractions and the prevention of premature delivery. As seen in Table 2, alcohol had an inhibitory effect on uterine activity in all cases. In 55 cases, there was complete cessation of the contractions, and in 26 cases there was a distinct reduction in intensity and frequency of the contractions. The prevention of delivery was considered *suc-*

TABLE 2.—*Effect of alcohol on uterine contractions and on outcome of labor*

Clinical criterium		INHIBITION OF CONTRACTIONS			PREVENTION OF DELIVERY		
		complete	*partial*	*none*	*succ.*	*equiv.*	*unsucc.*
Contractions	mild	22	6	0	16	9	3
	moderate	29	16	0	22	11	12
	strong	4	4	0	4	2	2
Membranes	intact	49	16	0	42	15	8
	ruptured	6	10	0	0	7	9
Cervical dilatation	0–1 cm	29	7	0	23	8	5
	2–3 cm	17	11	0	14	8	6
	4–5 cm	9	7	0	5	6	5
	7 cm	0	1	0	0	0	1

cessful if labor was arrested and delivery was postponed for at least three days (usually much longer, cf. Table 3). This occurred in 42 (65 percent) of the 65 patients with intact membranes, but in none of the 16 with ruptured membranes. The results were considered *equivocal* if labor was arrested initially but recurred and resulted in delivery within 48 hours, or if the pregnancy had to be terminated within this time for various maternal indications. Fifteen patients with intact and 7 with ruptured membranes fell in this category. The results were considered *unsuccessful* if labor could not be arrested and delivery took place within 24 hours (8 and 9 patients, respectively).

TABLE 3.—*Interval from initiation of therapy to delivery in the 42 successful cases*

Interval	*No. of patients*
3–7 days	9
8–14 days	7
15–28 days	5
29–56 days	8
57–84 days	8
85–107 days	5

The 81 pregnancies resulted in delivery of 87 infants (Table 4). Four of these were stillborn and 14 died in the neonatal period. A total of 37 infants reached the stage of maturity, and two more were only 20 grams below the 2,500 grams limit. The two neonatal deaths in the 1,501–2,000 grams group were due to erythroblastosis and congenital malformations, respectively. In no case did the alcohol treatment appear to have contributed to the neonatal death, nor did it have any depressive effect on the survivors; there were two survivors in the group weighing less than 1,000 grams.

TABLE 4.—*Perinatal mortality in the 87 infants in the first group*

Birth weight	*Stillborn*	*Neonatal death*	*Alive and well*
500 g or less	1	1	0
501–1000 g	2	6	2
1001–1500 g	0	4	3
1501–2000 g	0	3	9
2001–2500 g	1	0	18
2501–3000 g	0	0	21
3001 g or more	0	0	16
Total	4	14	69

One might speculate that the onset of premature labor could indicate that the intrauterine environment is no longer healthy for the fetus and that, in spite of the hazards of prematurity, it is safer outside the uterus. That this assumption is not generally correct when the membranes are intact is shown by our figures. However, no obstetrician would sit back and rely entirely on the alcohol treatment. The fetal condition is constantly monitored and, if fetal distress occurs, the fetus is delivered. With ruptured membranes, the situation is different and, at the moment, we exclude such cases from alcohol treatment.

It is very unlikely that alcohol acts in a similar manner as isoxsuprine. Although we still lack final proof, the evidence suggests that alcohol reduces uterine activity in labor by inhibition of oxytocin release. The final proof will be the demonstration of oxytocin in the jugular vein blood during premature labor and its absence after alcohol administration.

Contrary to an earlier report, alcohol in concentrations much higher than the therapeutic blood levels does not inhibit myometrial contractions *in vitro* (Landesman et al., to be published).

The beta-adrenergic compounds, which do act directly on the myometrium, show considerable promise. In our department, Landesman has studied several compounds related to isoxsuprine and some of different chemical nature. Were it not for the terribly slow procedure in obtaining permission for *in vivo* studies, we would have had much more infomation about their clinical usefulness.

Dr. Bishop does not regard hormones as being of any value in premature labor. Although the evidence for an effect of progestational compounds is disappointing, a pregnancy-maintaining effect of progesterone in the human has not been ruled out. If the role of progesterone is to keep the myometrium at rest, progestogens which are stronger or have a greater affinity to the myometrium might be developed, and new ways of administration is another possibility. It is also conceivable that an antioxytocin may be developed, a compound, perhaps of similar polypeptide nature, which would compete with oxytocin at the reception sites.

Inhibition of premature labor thus becomes a challenge to pharmacology, while prevention of prematurity is a challenge to public health. However, the obstetrician must collect the data, carry out the endocrine and physiological studies of labor, conduct the clinical trials, and decide when, and when not, to stop labor. Above all, therefore, the prevention of prematurity is a challenge to obstetrics.

RESPONSE

by

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The significance attached to the status of an infant at birth with respect to its ultimate mental capacity is reflected in the agenda of this National Conference for the Prevention of Mental Retardation Through Improved Maternity Care. Dr. Bishop, in his presentation, ably described some of the long-term deleterious consequences of birth to a fetus whose full intrauterine growth potential has not been realized. He reemphasized the urgency of the challenge to resolve the complex problem of premature delivery. He further discussed the role of social, economic, and educational factors in prematurity, and then pointed out that the needed improvements require the active involvement of "society as a whole."

Before I begin my discussion of Dr. Bishop's paper, I want to say that I am in full agreement with the major conclusions presented. In this presentation, therefore, it seems most fitting to expand on several points brought up by Dr. Bishop. The first is concerned with a potential relation of this Conference to "society as a whole." The second point is related to the need for a new definition of "adequate prenatal care." Finally, the "high risk" patient will be discussed.

Potential Relation to "Society as a Whole"

As noted by Dr. Bishop, one obligation of physicians is to stress the effects of social, economic, and educational influences on the occurrence of maternal and infant mortality and morbidity. I believe that this Conference can go even further; it can go into the area of helping to formulate sharper *definitions of long-term national goals and objectives of maternity care*. The reasons for this belief are two-fold. First, the subject "prematurity," its antecedents and sequellae, has been the basis for numerous meetings and conferences in recent years. What sets this Conference apart is that it is sponsored by the Children's Bureau which has as its chief mission service to the nation. As the scope of the enabling legislation for Children's Bureau programs has recently been expanded from the original restrictive category of the prevention of mental retardation and other handicapping conditions to include the charge to "help reduce infant and maternal mortality" (Social Security Amendments of 1967), so should the scope of this Conference now be expanded to catch up with that legislation; indeed, it should anticipate and help plan for the future. Realistic planning, in turn, requires the clearest possible formulation of objectives. Will our present stated goals allow that kind of planning? For example, within what conceptual framework should the problem of legal protection for working mothers be considered? Is the place of family planning, in terms of means and ends within health services, clearly understood by the public?

As an aid to the sharper development of goals, we might examine the working programs of Norway and Great Britain. The objectives of the Family and Child Welfare services in Norway have been described as being "—for the protection and support of families and the rising generation—." [1] More specifically, "—keeping down infant mortality, preventing illness and death in pregnancy and during delivery, ensuring children healthy development, and helping protect mothers from the many strains of bearing and rearing children." [2] With respect to Great Britain, the Cranbrook Committee stated: "The success of a maternity service is to be measured by the saving of life, by the improvement in the standard of health of mothers and babies, and also by the extent to which it can diminish the fears, difficulties, and discomforts which, in some measure, have to be faced by every woman who embarks on motherhood." [3] The development of goals and standards such as these would help place the problem of mental retardation in its proper perspective within the total framework of maternity care. This would also allow more refined estimates about emphasis and resources to be allocated to the problems of mental retardation as compared to other aspects of maternity care.

The second reason for the belief that clearly defined objectives are particularly needed now stems from an observation of Evang,[2] who stated:

> "Norway has been able to develop such an extensive system of health services in spite of economic and geographic handicaps only because of the general agreement of a well-informed public opinion on the ends and means of the program."

If this point of view is applicable here, the question then arises as to how much of the present-day difficulties in obtaining public support for maternity care programs is because the public is not clear about objectives, or because they are confused about ends and means. In addition, the establishment of long-term aims and objectives and clear distinctions between ends and means would seem to be essential in this period of intense examinations of the American health care system[4,5,6] and even of the therapeutic usefulness of contemporary medical science.[7]

"Adequate" Prenatal Care

The need for the clarification of long-term aims and objectives can again be seen when attention is turned to the question: what is adequate prenatal care? Following a description of the kinds of services too often provided to pregnant women, Dr. Bishop points out the need for a rigorous contemporary redefinition of maternity care. What that new definition might be would largely depend on the goals and objectives of a maternity care program. For example, if the main objectives were to be limited to the prevention of prematurity, then one kind of working definition would be developed. On the other hand, if the broad definition of maternity care developed by the WHO Expert Committee on Maternal and Child Health[8] were to be adopted, then a wholly different concept of adequacy of service would evolve.

The final definition, in turn, would determine the nature of professional services and facilities required and the manner in which those services would be provided. It would also help shape the scope and directions of supporting organizations, such as the Children's Bureau itself.

Along with his description of inadequate maternity services, Dr. Bishop described the success of recent programs to reduce prematurity at the Pennsylvania Hospital. He also mentioned an earlier study at that institution conducted by Tompkins and associates between the years 1947 and 1953. In that earlier study, they demonstrated what can be done to assist the most needy women to have more successful outcomes of pregnancy. With the combined use of a skilled staff and special nutritional services, they could reduce the incidence of toxemia to 0. 6 precent, and of premature births to less than 5 percent.[9] This yardstick is particularly useful now with the development of the health team concept and the many other foreseeable changes in methods for the delivery of health services. Will these new methods of service provide quality care? For example, take two of the most obvious aspects that can affect the outcome. How important is the kind of continuity and personal involvement provided in the Philadelphia study, and how might it be provided in these new settings? Who will provide comparable nutritional services, and under what circumstances? How can pregnant women be assured of access to the foods they are directed to eat? Might the Federal Food Stamp Program be adapted to this purpose? Could such a program be made a regular part of maternity care?

High Risk Pregnancy

Although certain characteristics of pregnant women, such as age, height, race, and economic status, are usually included in lists of factors which can be related to the risk of an undesirable outcome of a pregnancy,[10] precisely how these characteristics might exert their influence remains unclear. More importantly for this discussion, in the case of the four characteristics just cited, it can be shown that whatever undesirable influences each of them might have, they can be overridden or modified by social, economic, and/or nutritional factors.[11]

The circumstance of being poor has, in itself, been strongly associated with an increased risk of premature labor. With respect to the subject of race and how it might relate to social class, opinions vary widely among sociologists and anthropologists concerning whether race should be considered fundamentally a biological problem or one of social and economic status and opportunities. For example, Myrdal, in reference to the relation of race and social class in the United States, recently stated, "The dividing line in America is not biological, as I think it is in some parts of the world, but a social one. It is not race, but racial beliefs, which are fundamental to the rigid barrier." [12] Certainly, it would be misleading to invoke racial factors as the sole explanation for differences in the incidences of prematurity between major racial groups without first eliminating other potentially overriding social, economic, and nutritional differences.

Even the manner in which factors shown to be associated with a high risk of premature labor are assembled and presented needs careful attention. This need arises because the inclusion of factors may be interpreted in some instances as implying that they are, therefore, strong determinants of the weight of the infant at birth and, hence, of the incidence of prematurity. This interpretation might tend to foster the belief that the incidence of prematurity and its deleterious sequellae are, in the main, unmodifiable by preventive and prophylactic services for pregnant women. This belief may then be used tacitly to help explain away the ineffectiveness of some methods for the provision of maternity services. But the faults in this chain of reasoning are shown again by the repeated demonstrations at the Pennsylvania Hospital that substantial improvements can be accomplished.

Rather than considering these associated factors as determinants, might it not be more appropriate to employ them as means to estimate the kinds of problems which might be encountered in efforts to help improve the outcome of a woman's pregnancy?

From the point of view of the need for an overall comprehension of the problems of a maternity service, epidemiological descriptions and statistical associations are, of course, indispensible. But estimates concerning how the many factors might relate in individual circumstances require much more study. The task of translating the results of such studies into therapeutic measures and then of making them accessible to those women in need will be even more challenging.

In conclusion, I would like to urge again that we begin action on Dr. Bishop's call for a redefinition of maternity care. I would only add that, in my opinion, the drafting of a definition which would meet present and foreseeable needs requires, as an antecedent, the clearest possible formulation of national objectives.

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RESPONSE

by

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Douglas Murphy, in his 1947 monograph on uterine contractility in pregnancy, reported two patients who experienced unusually early false labors which presented a labor type of pattern on observation with the single channel tocograph. These two women were the only patients who gave birth to premature infants in the series that he observed. According to a table in his book, two other infants were similarly born premature by weight, but this was a pair of twins and Murphy did not feel that these could be clearly interpreted. However, he suggested that observation of a labor type pattern at the time of false labor early in pregnancy might provide the basis for the early initiation of prophylactic therapy.

Subsequent observations with the multiple channel electric tocodynamometer and with intrauterine catheters in the last 15 years have, unfortunately, failed to bear out Murphy's impressions with sufficient accuracy to allow for reasonable prediction. In a study of the contractile behavior of the uterus during pregnancy, I was able to observe that there were developing patterns of coordination of contraction and what has been called "fundal dominance" as pregnancy proceeded. Unfortunately, among the experimental patients I was able to study, there were so few premature labors that it was not possible to say with any certainty that the evolution of this kind of pattern took place reliably earlier in a patient destined to deliver a premature infant than in other cases. Indeed, it was possible to note so many exceptions to the rule that the pattern of uterine contractions could not be used to erect any reliable predictions as to the date of the onset of labor. These exceptions existed in both directions. A number of patients were observed who had striking regular uterine activity with fundal dominance by the 30th week. These women were consistently the patients who complained of uncomfortable Braxton Hicks contractions. Nevertheless, they delivered at what appeared to be term with the same frequency as the group of patients as a whole. At the other end of the scale, there were patients who had minimal uterine activity until quite close to term and, nevertheless, exhibited normal labor contractile patterns. What this amounts to, in summary, is that the pattern of uterine activity, insofar as it is possible to study it at the present time, cannot be used as a prediction of the date of the onset of labor.

Difficulty further arises from the fact that in regard to many causes of prematurity, it has not been fully demonstrated whether the cause is a cause of the premature onset of labor or of the birth of a low birth weight infant or, indeed, of both. Yerushalmy's data certainly suggest that in large populations of patients, these are related variables. From a theoretical standpoint, however, it is certainly possible to conceive of a situation in which a cause of the premature onset of labor exists which, in fact, has no impact on the growth or development of the fetus up to the moment that labor ensues. In an obviously pathological condition such as the incompetent cervix syndrome, this is unquestionably present. The problem to which we do not have a clear answer is how often this is present in what is regarded as simple premature labor.

Since we are presently not agreed upon a definition of prematurity which relies on entirely objective criteria of maturation, as manifest by response to physiological tests, it cannot be stated with any assurance at all that premature labor and prematurity are coextensive phenomena. Is it not conceivable that there is a low birth weight infant who is, in fact, otherwise normal? May there not be a group of such infants whose prognosis is quite as good as that of their heavier siblings, and still another group in whom low birth weight is a manifestation of a pathological process which worsens prognosis? In this regard, it might be worthwhile to call attention to the striking reduction in birth weight observed in the children of cigarette smokers, an effect which is apparently present whether the mother or the father smokes the cigarettes. Another observation in point is the incidence of prematurity in three separate Asiatic populations observed on Oahu: the Japanese, Chinese, and Filipinos, all having similar rates of prematurity by weight but strikingly different perinatal mortality rates.

Finally, the incidence of prematurity is highest in the United States for the Mountain States area; in fact, the mean weight of newborns is lowest for this area. Nevertheless, Utah, with a strikingly low mean newborn weight, has the lowest perinatal mortality in the Union.

There is agreement in regard to the *anomalous* infant—that it is ordinarily born prematurely, very frequently is of decreased birth weight, and has a poor prognosis.

Large populations that are not carefully sorted, however, will drop into the wrong category infants who are premature by dates but not by weight because of maternal diabetes or edema related to isoimmunization or the unexplained hydrops syndrome.

As noted above, it is not possible at the present time to rule out the possibility that patients who fall into premature labor actually consist of at least two separate groups: in one, the premature labor is associated with fetal or placental defect so that prolongation of pregnancy might possibly worsen fetal prognosis; and in another group, the onset of labor is utterly unrelated to fetal factors and may be the consequence of anatomical defect in the mother. In this latter instance, prolongation of pregnancy could be expected to be of benefit. This is the group toward which drug therapy can reasonably be directed.

It is now known that in the period of recovery from World War II, the mean newborn weight of infants in Japan has increased. This has occurred without any meaningful change in recorded length of pregnancy. Unfortunately, we do not know what this change has done to perinatal mortality rates.

It should be pointed out that it is a great temptation to simplify the socioeconomic aspects of the prematurity problem and, indeed, as the basis of a program for social action, it may be necessary to do this. However, it should be kept firmly in mind that this may not be as simple as it appears. The great difficulty in interpreting the meaning of the observation of the correlation of premature infants with mothers with small heart size is an example of this. There seems to be very little question that the woman with an actual or a relative small heart volume is more likely to deliver a premature infant than her sister with a normal volume. It is by no means clear, however, whether this provides any rational basis for prophylactic therapy. No satisfactory experimental series has been studied. The latest careful report of this from Finland, in which the low heart volume mother who was put on a special regimen had fewer prematures, nevertheless has to admit that these were not randomly selected but self-selected mothers. In retrospect, they were almost certainly the patients whose prognosis in the first instance was better among those with low heart volumes.

In conclusion, it might be worthwhile to recall two experiments to which Reynolds called attention 20 years ago in a paper on the subject of prematurity. The wild hare has a duration of pregnancy of 56 days and produces baby hares whose eyes are open, which have normal postural reflexes, a full set of fur, and almost adult primping behavior. The laboratory rabbit, on the other hand, produces grossly immature pups at 32 days of gestation. If a male hare is mated with a rabbit doe, the rabbit doe produces pups after 32 days which look like rabbits and not hare neonates. There is, therefore, a genetic effect on duration of pregnancy. The other experiment involves the mating of the Shire horse with the Shetland pony, there being a gross disparity in the size of these two animals. If a Shire is mated with a Shetland female, pregnancy proceeds to its normal duration, but the newborn is always of the appropriate size for the Shetland and not for its father. There is, therefore, a maternal impact on fetal size in this species, unrelated to duration of pregnancy.

From the human observations presently available, it appears that there are genetic as well as socioeconomic impacts on the incidence of prematurity and its prognosis.

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GENERAL DISCUSSION

Dr. Benson: Dr. Bishop's paper was excellent. I especially appreciated the graphs and tables with special reference to the reduction of prematurity. I'm referring now to births under 37 weeks in a control series within a single hospital, just as Drs. Gold and Stone did. This was on the basis of (1) prophylaxis through education; (2) early recognition of high risk patients; and (3) the institution of specific treatment for some of the patients involved. This included drug therapy, such as you have heard. They, incidentally, did not relegate clinic duties to the least skilled and least experienced staff, but to their best. The cytology of the amniotic fluid as a guide for the determination of maturity was, I thought, an excellent practical point.

I am still contemplating the Philadelphia experience with respect to heart size. From his paper, I could [illegible] determine if Dr. Bishop was talking about "lowbies" or about "preemies," but perhaps he will make this distinction for us later. Bed rest was mentioned for diabetics and the possible beneficial effects associated with the beta-adrenergic agents, but there was no mention of multiple pregnancy.

Some nutritional studies were described by Dr. Bishop, in addition to those described by Dr. Tompkins. I'm not certain we shouldn't go further with the biomedical studies which Dr. Gold mentioned yesterday. I hope we can emphasize protein intake.

Dr. Benirschke beautifully outlined a comparison between the autopsy surgeon and the clinic physician. The message was clear that we should reorganize and regroup with better talent in the clinic. Actually, the clinic is a medical laboratory. Dr. Jacobson made this comment in an earlier Session, and I believe this is an important concept. All of the scientific criteria can be utilized here just as well as in a chemistry lab. For example, we all need additional staff and equipment, such as ultrasound. There was a time when X-ray was an esoteric instrument but it is vitally needed now, and I feel the same way about ultrasound. I wish we could all enjoy the excellent clinical and anatomical pathology collaboration which Dr. Benirschke mentioned in his paper. Whether infection is the cause of the premature rupture of the membranes or whether the inflammation is the result is, perhaps, not too important. We all agree that premature and prolonged rupture of the membranes is an indication for induction of labor at 36 weeks, and certainly in the face of infection which is worse in prematures. So, 34 weeks is an acceptable 2-week difference, and this is about where we stand. If you feel differently, I hope you will express your views.

Dr. Fuchs made some excellent points. We do not know the cause of labor, but, if we knew how to stop it, we would probably have half the answer. His study with intravenous alcohol is one of the bright new approaches to this problem. He has stated that this will have to be controlled.

The problem would be much easier if we knew how to date the onset of labor. If we could keep the patient out of labor for any extensive period of time, this would help also. But whether we can extend gestation significantly to reduce perinatal mortality and morbidity is yet to be shown.

I appreciated Dr. Kaiser's references to the personal use of the multiple channel tocodynamometer and prelabor patterns. The mean weight of the neonates may be lower than in other parts of the United States, but are these really premature babies? Are they truly 37 weeks or less, or simply low birth weight babies? I suspect it might be the latter, because the mortality should be higher if this were not the case. Our pediatric colleagues have reminded us that we should use more and newer indices of maturity. I am thinking of Usher's description of planter creases, scrotal wrinkling, and characteristic variations in head hair which, for the obstetrician, will help a good deal in an estimate of maturity, beyond the use of the X-ray for ossification centers.

Obviously, Dr. Bishop's cytology studies will help much more in an earlier sense than this, but this can be a followup and can help to identify some of the dysmature children whom we deliver. In any event, we should stress gestational age far more than we do and compensate for this by good followup. The pediatrician or the psychologist would check infants at 8 months and later at 1 year.

Dr. Kaiser's reference to the hare and the rabbit, and the Shetland and Shire horse crosses, was fascinating. Clearly, genetics is very important.

This panel has focussed attention on the avoidance and the prevention of untimely delivery. The possibility that some of the premature labors—those under 37 weeks—might be turned off, so to speak, by medication admittedly will reduce the number of gravidas at risk, but by a very small margin, and this is because we need selection, hospitalization, and monitoring. It will be easier, of course, to apply alcohol and some of the other drugs mentioned. Nevertheless, I dream that someday, someone will be able to control labor so we will be able to lock the door of one of the premature nurseries and throw away the key. We will still have to keep one of the premature nurseries, however, because of the premature rupture problems and others, such as the multiple pregnancy. This is a long bow, but, with the pursuance of the pharmacology of labor, I believe this will come about.

Later in this discussion, a much broader, far more timely and urgent problem was introduced by Dr. Jacobson. What should our national goals be, and what should the standards be for maternity care in this country? How can this best be provided? I am greatly stimulated by the possibility that we might be able to define adequate prenatal care or, at least, begin this task at this Conference. From the teaching, service, and research point of view, this would advance obstetrics and pediatrics immeasurably. As it is, even in some of our larger centers, high button shoes obstetrics is still being practiced. Our problem clearly involves social and educational planning, and, although all of us hope research will be interrelated and continued, I, for one, am very glad we are finally talking about service. Dr. Jacobson mentioned narrow goals such as the prevention of prematurity, and then he spoke of broader goals such as a better life and better health for the family unit. I feel that we should accept the wider perspective, perhaps with a step-wise approach to a solution of the problems we have been discussing and will continue to discuss at this Session.

Dr. Stone: The presentations by the obstetricians and gynecologists at this Session have been superb. What I would like to do now, however, is ask some very specific questions.

Dr. Benirschke, would you expand somewhat on the organism described in the *Science* article. You said that it is sensitive to antibiotics, but you did did not say which one. We are all concerned, particularly our pediatric colleagues, because of problems that result from antibiotics.

I am confused, Dr. Fuchs, as to what "work" means as compared to housework. In the category of "working," I find it difficult to accept the girl who has three coffee breaks, sits at her desk a little while and uses an electric typewriter as working harder than the multipara who is running a household with a number of children around. I find it difficult to compare the two groups.

I believe we settled the matter of bacteriuria in pregnancy—or some of us are satisfied that we settled it. Perhaps we can do the same with small heart volume so that we understand whether that is, or is not, a factor.

We have used intravenous alcohol following the recommendations of Dr. Fuchs, although in a much smaller series. I mention it only to confirm that it will definitely stop uterine contractions. It is practically impossible, I believe, even with Dr. Terris' help, for us to set up a controlled study for this. But I submit that if it is used extensively, in properly selected cases, the sheer volume of numbers will, in the long run, give us some conclusions—the same as we achieved in obstetrics, clinically, with intravenous oxytocin for acceleration and induction of labor; much of the control and laboratory work followed wide clinical usage where the sheer volume indicated that it was effective.

Dr. Benirschke: The organism I described is mycoplasma T. Mycoplasma is a "PPLO," pleuro-pneumonia-like-organism, and has been notoriously difficult to culture. Moreover, in the last few years, much has been learned regarding the interaction of mycoplasma in man. It is well established that mycoplasma causes a variety of diseases in man. This is mainly mycoplasma hominus, which is easily cultured and fairly well understood as far as atypical pneumonia is concerned. It has been recognized as a frequent contaminant of the uterus, cervix, and vagina of many pregnant women. At present, we do not understand what it does in harming pregnancy, or in damage to the vaginal tract in general. In cattle and in a variety of domestic animals, mycoplasma infection of the genital tract is a very serious sequel of semen distribution from semen donors containing mycoplasma organisms. It causes, among other things, salpingitis, abortions, and so on, in a variety of domestic animals where different mycoplasma organisms are well recognized.

Mycoplasma T has been recognized only for the first time in this study, and it is immunologically, size-wise and culturally, an entirely different organism. It has, heretofore, not been cultured, and requires very special agars and isolation mechanisms for identification. I am deeply interested in pushing this, because the very frequency with which we, as pathologists, have recognized the intrauterine infection syndrome in the absence of recognizable bacteria has led to much speculation. Many different types of treatment and studies have been held back because of the inability to associate the inflammatory reaction with an infectious agent. These studies have been criticized for this reason. On the other hand, when there is an infectious agent, usually a gram negative rod, it is almost invariably associated with the inflammatory event. This agent is treatable with tetracyclines and erythromycin.

Dr. Wallace: At the present time, I do not believe that we in the United States are ready to do a redefinition of prenatal care. I have never been satisfied that we really know what the essential ingredients are of prenatal care, nor have I seen that we have made any progress in this field. The only essential ingredient of prenatal care that I can define for myself is nutrition. For probably the last 20 years, we have gone through the same rituals of prenatal care over and over again with millions of women, without being able to clearly identify which areas of care are genuinely important and which are not. One of the most urgent needs at the present time is a series of good studies aimed at evaluating what facets of prenatal care should be retained and how we can eliminate those that are less important, thereby cutting down on personnel and expense.

I am not convinced that the traditional schedule of recommended visits for prenatal care is the best schedule. I am intrigued, for example, that we start with a very loose schedule of infrequent visits early in pregnancy, and we begin to build this up—and, if we really look at the whole picture of fetal loss, it's the other way around.

My next comment relates to the question of the higher incidence of low birth weight in working mothers. A very large number of women of childbearing age are in the labor force of our country. We know that they work primarily for economic reasons. Couldn't we look at this from a preventive point of view? If it is true that working women have a higher incidence of low birth weight infants, and if it is true they work for economic reasons, I wonder to what extent we could put these two factors together and do some type of income maintenance that might be more effective in prevention. The whole question of outcome of pregnancy in working mothers needs to be looked at. I would like to suggest that the Children's Bureau (and this is a specific recommendation) consider this issue with the obstetric profession, the people in occupational health, and, hopefully, with some people in the field of maternal and child health. I see the need for standards and methods by which women who are working and who are pregnant will be permitted time off for prenatal care. I feel the need to do something about the appopriateness of the type of work. This is an important area that needs elucidation, and I see a number of professional disciplines that might make a contribution to this field.

Dr. Fuchs: I am unable to define optimal antenatal care, but there is a deficiency in present antenatal care that I should have pointed out in my response to Dr. Bishop's paper. Usually, in the beginning of pregnancy, we talk to the patients about what can happen in early pregnancy, about miscarriage, and then they usually ask how they will know when they are really in labor. We then talk about labor as if it is always going to happen at term. We tell them to come to the hospital when the contractions are regular and every 5 to 10 minutes. We usually fail to tell them that labor can come on prematurely and what to do then. If we inserted a little advice about coming to the hospital immediately if symptoms of premature labor occur, it would help.

We have seen, both with uterine relaxant drugs and with alcohol, that the number of patients who can be treated is very small, because most of them come to us too late for the treatment to have any effect. If, in our antenatal clinics, we added the advice that patients should come in immediately if they have symptoms, or if they think something is unusual, then, even if this were to result in the observation of more patients in the admission area, it would probably be helpful.

With respect to the question of working mothers, I feel that those of us who have working mothers as patients realize that even if they do spend 8 hours at an electric typewriter with a number of coffee breaks and lots of relaxation, they still have a considerable amount of work to do when they get home. So, there is a difference. In the material that has been analyzed, it is very difficult to break down the categories of how strenuous the labor is.

Dr. Clifford: I would like to react to some suggestions made by Dr. Wallace. One dealt with income maintenance. I wonder if there shouldn't be studies that look to the future, say 5 or 10 years from now, concerning what the effects would be of the proposals of an annual wage as a substitute for relief as it is now practiced. Some feel this would be much more economical and useful. Perhaps exploration of this field is timely and pertinent. Can someone enlighten us in this area?

The other area of my concern is antenatal care. Dr. Fuchs mentioned advising a patient who comes to a clinic about the possibility of having premature labor. We have one example of very excellent prenatal advice in a situation where we can have a high prediction of outcome, namely in the RH babies—the women who have had erythroblastotic babies. They are alerted immediately, as soon as the possibility of an RH negative mother and an RH positive father is present. These patients are promptly put in high risk clinics that are an example of what we are aiming for. On the other hand, I wonder how many of the obstetricians here have actually informed their patients of the risk of repetitive pregnancies at the time they are most receptive. This is the time when the education is accepted, even by people of low motivation. This then leads to successful interconceptional care.

Dr. Jacobson: I would like to comment on the whole subject of the repetitive nature of the birth of a low birth weight baby. If the same circumstances are present during the second pregnancy as the first, and nothing happened either time in a positive sense, why would a different outcome be expected? I used to ask residents at Boston City (Hospital) if they ever questioned women patients regarding what they ate. They said they did not—because the women might tell them and, if they did, what were they to do about it? If you are unable to modify people's work habits, is it reasonable to expect that they will rest if it's impossible? Thus, if one is simply seeing impossible circumstances in repeated pregnancies, insofar as they are modifiable, then there will be the same outcome in successive pregnancies.

Dr. Felton: With a team approach and the use of associates who have many techniques which we as physicians do not have, and which are helpful in supporting and maintaining these patients, there would be more elements of a positive nature. But we must allow our associates to participate more fully. This whole field—the support that a well-qualified public health nurse together with a medical social work consultant at various levels can provide—can contribute to a better total situation for many working mothers.

We have bandied about the idea of homemaker service. Do we really know what we're talking about? There are modifications; there are patterns; the field is wide open in the use of auxiliary help to the woman in the home. We haven't even scratched the surface in this area. The physician alone cannot do this. There are other people better qualified to bring in these very important adjuncts to the care of the pregnant woman.

Dr. Benirschke: The physician does not exploit all of his resources. I do not believe it is necessary only to consider whether the physician gives advice; the obstetrician does give advice to the woman who has repetitive failures at 20 weeks, and he tries to do his best. But he does not use the potential of investigation that is necessary to prevent these recurrent tragedies.

Dr. Bishop showed us that with babies under 1,000 grams, repetition occurred in 46 percent of his cases, and the woman who has had two babies at 22 weeks is very apt to have a third, fourth, and fifth one. This is where I disagree sharply with Dr. Benson's inference that it doesn't matter whether infection occurs before or after rupture of the membranes. The facts are, if these early pregnancies or early deliveries are sufficiently examined, 70 or 80 percent of them have chorioamnionitis or deciduitis. It is this examination, I believe, which is almost invariably lacking. Chromosome studies are occasionally helpful in this respect. I think it is now possible to investigate these from an inflammatory, infectious point of view, heretofore impossible, and to really make an impact interconceptionally by considering treatment of the husband as well as the wife. Treat them—don't just give them advice.

Dr. Benson: We agree entirely with you, Dr. Benirschke. My point was made with respect to a situation—a fait accompli—that we have a patient with ruptured membranes, and what are we going to do about this? Your suggestion that this might very well be an infectious process, cervicitis, is most vital. We have often not followed this up. But I was not considering the long-term problem. I couldn't agree with you more.

Dr. J. D. Thompson: I would like to make a comment about Dr. Clifford's excellent remark concerning the education of expectant mothers in the immediate postpartum period. My comment relates to the period of time of hospitalization for postpartum mothers. Of course, wide variations exist in this country with reference to how long a mother stays in the hospital following delivery. A large number of patients, particularly in the Southeast, never get to the hospital to begin with, and are not seen by a trained medical attendant during labor, delivery, or in the postpartum period. Also, a large number of hospitals in this country that are responsible for the care of indigent expectant mothers can keep them for only 1 day following delivery. This was the situation in my hospital until several years ago. We have now been able to extend the period of postpartum stay to about 3 days. Obviously, if the mother is sick, has had a cesarean section or some other problem, she can stay as long as necessary. I have been informed that a law has recently been passed in France requiring the mother to stay in the hospital 12 days after delivery. This is an example of the considerably greater emphasis placed on maternal health and the quality of human reproduction by other countries compared to our own.

Concerning the postpartum stay, I do not believe an extended postpartum stay is necessary in order to prevent complications of the pregnancy that might occur. For example, we very infrequently need to readmit patients to the hospital to treat certain complications. On the other hand, there are two very important benefits that might stem from an extended postpartum stay: first, the opportunity the pediatricians would have of detecting the presence of abnormalities in the infant; second, the opportunity to mount a much broader and in-depth educational program for the mother who has just delivered. I would be in favor of an extended postpartum stay if this could be done.

In regard to the question of work in pregnancy, I made a few remarks earlier in the Conference concerning the premature birth rate for women who pick cotton. We need to be concerned about how strenuous work should be for certain expectant mothers. But there are three other examples of the influence of work on pregnancy I feel I should relate to you.

First, I recently discovered an early expectant mother who worked as a dental technician. It was her responsibility to take X-rays of the teeth. No recognition was made of the possible adverse effects of exposing her to radiation in her early pregnancy. I understand from my radiologic colleagues that some of the X-ray machines in doctors' offices, and I assume that includes dentists', are among the dirtiest, in terms of the amount of exposure.

Secondly, I came across a patient in our hospital who had not come for antepartum care, and, as is my custom, I tried to find out why. Her reason was that she worked in a cafeteria and was afraid that if she took time off to come to the clinic, she would lose her job. Interestingly enough, she worked in a hospital cafeteria in another hospital in our city. This example demonstrates how women in this country are punished for being pregnant. Might it not be possible for us, in some way, to help people in industry and business to recognize how important it is to give their women employees time off for antepartum care?

My third example concerns the rule our school system has, and I believe it is present in school systems all over the country, that a teacher who is pregnant must leave her teaching position when she begins "to show." If her welfare and the welfare of her unborn child were uppermost in importance in people's minds, she should be given a leave of absence for about the first 3 months of her pregnancy so she would not be exposed to the contagious diseases so prevalent in the classrooms—rubella being a very important example of this. Then she should be allowed to return to teach for as long as she feels like it, as long as she wants to, and as long as her doctor approves. There are many parameters to this question of work in pregnancy that should be taken into consideration.

Dr. Flowers: I would like to respond to Dr. Wallace's remarks about prenatal care. First, of course, we must have a motivated patient, and we must never cease in our efforts to think imaginatively about how we can ensure that women have pregnancies that they desire. Next, I feel that we have much to offer in prenatal care, and most important is education. I am pleased to say that our project now has a portable retroscreen projector and a number of filmstrips. It is remarkable to see not only the patient, but her husband, focussed on this little box. Our real regret is that we have such an inadequate number of films. These women can be educated in so many ways and about so much that we know is important. But they are not getting this education because doctors or nurses just don't have the time. If we are going to spend money on prenatal care, then improving the methods by which we can educate large groups of women concerning all the areas we have talked about—preconceptional health, conceptional health, intrapartum health, prenatal care, postnatal care—is imperative.

I find it very difficult to accomplish something I feel is very important—preparation for childbirth. If we have a patient who understands the mechanisms of labor, who can appreciate participation in labor, we will measurably reduce the amount of analgesia and anesthesia now needed. We may measurably reduce the number of women who have uterine dysfunctional type labors. This can be accomplished by improved educational techniques.

Next, nutrition presents a problem for me. I have people in Houston who are hungry. The patients tell me they are hungry and the social workers tell me they are hungry, but I have no way of getting food to these women. It seems as if the people responsible for giving food put the dispensing areas in parts of town that are difficult to reach and require transportation. Frequently, these people do not have money to hire someone to take them to where the food is. If we are going to use surplus food, and we are going to try to improve nutrition in our prenatal clinics, then we must have the food right there so patients can use it.

Prenatal care is not just putting the hands on the abdomen, taking blood pressure, or examining urine. Prenatal care now is very sophisticated. We must have laboratories equipped to do estriol determinations, diamine oxidase levels, to study the amount of glucose in the amniotic fluid. We must have laboratories that will allow us to know if we are having problems of renal clearance. I propose, therefore, that the basic aspects of prenatal care are going to be varied by the complications, and we must develop high risk clinics. We must not forget the average girl, because she can shift to high risk clinics at any time. But we need to improve motivation; we need to give education; we need to improve nutrition by making it available; and, next, we need to spend money for proper laboratory techniques in order to extend the hands of the obstetrician.

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Dr. Wallace: I want to be sure that I am, at least, partially understood. I believe in prenatal care, but I want to know what it is I believe in; I want to know what it is essential to believe in. As I see it, there is quite a difference between the routine screening procedures that might be available and applied to large numbers of pregnant women on the one hand, and the routine screening procedures necessary to identify women who are likely to have difficulty and need the more sophisticated kinds of care and workup on the other. I see this as two distinct kinds of problems. We have not defined for ourselves the routine screening necessary to identify the women who need the more specialized care.

Dr. Benson: Dr. Wallace, I find in our area of the country that most problems relate to errors of omission rather than of commission. I believe we would all like to know why we are doing this, but even the simpler tests, as you have indicated, are not done; this is even the case in many private offices.

We should leave liability, in the legal sense, out of our discussion. No one is interested in prosecution. But, the pursuance of adequacy is paramount—and I do not see how maternity care can be improved without saying what the basic needs are.

Dr. Pearse: Dr. Wallace's views are not really irreconcilable with Dr. Flowers'. What Dr. Wallace is calling for, I believe, and what we ought to do, is something similar to what Dr. Robert Cook is undertaking at Johns Hopkins—a systems analysis approach to outpatient care. What Dr. Cook is attempting to do is to identify which elements of care are likely to be rewarding in terms of diagnosis and intervention, and which elements in terms of either time or cost, are not likely to be rewarding. I believe the same idea would be of benefit if applied to prenatal care.

Dr. Fomon: At one point in Dr. Terris' paper, he came to the conclusion that the evidence is overwhelming that there is no relationship between asymptomatic bacteriuria and prematurity. He said that this, for him, is a closed book—something we no further have to worry about. A remark made by Dr. Stone suggests that he believes this also. As far as I am concerned, when I look at the evidence I see nothing that has established a lack of association between bacteriuria and prematurity. We do not know what the nature of the relationship is, or even whether there is a relationship, but if we close our minds to the possibility that a relationship may exist, we will have absolutely overlooked an impressive bit of circumstantial evidence. The 20 reports that Dr. Terris referred to are, in some respects, a red herring. We do not want to say that there are 3 reports that favor this idea and 17 reports that do not, and then say that because 17 is more than 3, this is the weight of evidence. What we want to do is look at which reports are really sound; in which cases are the diagnoses acceptable? If we begin looking at them, we at least can say there is not only the report of Kass which is suggestive, but others, such as the report of Stewart et al. These, the 18 or 19 that did not support the Kass thesis (although one can raise objections about their interpretation), really do not provide evidence against the relationship. If anything, they provide suggestive evidence *for* it. Dr. Henderson's report looked convincing, but, I believe, we cannot evaluate that—it is unpublished. I am not willing to accept information when I have been unable to review the paper. To me, therefore, this issue remains an open book. I am not convinced, and I do not know how many are.

Dr. Gold: When Dr. Kass' initial reports appeared, I became extremely interested and went to visit him. A study was then set up in a large voluntary hospital service of which I was, at that time, the Director. This involved a clinic service to approximately 2,500 patients a year, predominantly non-white, low socioeconomic. This 2-year study was published. We went far beyond Dr. Kass' attempts to pick up asymptomatic bacteriuria. In our study, almost 2,000 patients in the 2 years had midstream catch determinations done at each prenatal visit. We found that the incidence of asymptomatic bacteriuria was very similar to Dr. Kass' in the low socioeconomic groups that he had studied. We found a number of areas, however, that Dr. Kass tended not to call attention to; namely, that asymptomatic bacteriuria appeared at any trimester of pregnancy. There was spontaneous resolution of asymptomatic bacteriuria in about 65 percent of our patients as pregnancy progressed. In our treated asymptomatic bacteriurics as contrasted to our control group of untreated asymptomatic bacteriurics, we had no prematures in the untreated group; in the treated asymptomatic bacteriurics, we had the same incidence of premature birth as we had in the general clinic population for that socioeconomic level, namely 14 percent.

When I first saw Dr. Kass' initial study, it seemed he had probably, or possibly, put his finger on an exceedingly important public health aspect that we could relate to prenatal care; namely, the investigation and treatment of asymptomatic bacteriuria in an effort to reduce the incidence of low birth weight infants or premature infants. What has eventuated from Dr. Terris' exceedingly detailed analysis of the literature, from the epidemiologist's point of view, is that there is, in fact, on analyzing the studies, no relation between asymptomatic bacteriuria and prematurity per se. What Dr. Terris and all of the investigators have found (including our own investigation) is that there is an association between asymptomatic bacteriuria and the development of clinical pyelonephritis during pregnancy, and that clinical pyelonephritis is associated with an increased incidence of low birth weight and premature, by date, delivery. So, from this point of view, there is a relationship. However, with the antepartum patient with clinical pyelonephritis, this is such a definitive yardstick and endpoint, and with effective therapy we can so readily control the disease, that this is not a very significant cause for a premature birth or a low birth weight infant.

Dr. Henderson: I would like to apologize to Dr. Foman because Dr. Stone and I, with another 10 or 12 investigators, have some information you do not have. We spent about 15 months developing a collaborative clinical trial protocol to treat this condition on a control basis. All the evidence from all the investigators was given to a council appointed to review the problem to determine whether it should be supported. This council came to the conclusion that there was absolutely no evidence for an association and, therefore, no evidence that the National Institutes of Health should support a clinical trial. That is why I felt there was no need to publish any more evidence.

Dr. Jacobson: Dr. Pearse raised a very important issue which, I believe, is the whole problem of systems analysis—cost effectiveness, and so on. To me, this makes the establishing of aims and objectives all the more important, because studying the cost effectiveness of a program depends on what it is you want to accomplish. If it's the prevention of prematurity, then one set of data goes into the computer; if it's the needs of the patient, then another set. For example, if we go back to the WHO definition of what constitutes a maternity service and what kinds of services people are entitled to and might need, then attention must be given to what is being studied: how is it to be measured? can it be measured? if it cannot, does that mean it is not useful? The Cranbook report (from which I read during my presentation) points out that one of the purposes of a service, or the effectiveness of a service, is to be measured by the extent to which it can diminish the fears, difficulties, and discomforts which, in some measure, have to be faced by every woman who embarks on motherhood. I come back to some such objective as being the first input into the computer and not the last.

Dr. Gellis: I am not here to defend any particular side, but I would like to point out for Dr. Henderson's benefit that about 10 or 15 years ago, a council reviewed the proposal that amniotic fluid be studied in mothers of erythroblastotic infants. The conclusion was that nothing would be gained from such a study, and support was refused.

Dr. Terris: I do not know if we want to go into the details of the Kass experiment, but I believe Dr. Henderson knows a great deal about the selection of cases and controls. I think it sheds a great deal of light on what actually happened, and perhaps Dr. Henderson would be willing to discuss it.

Dr. Henderson The only information I really have is that the individuals who reviewed all our data, including Dr. Kass, made a different interpretation of Dr. Kass' data. That is the information we, as investigators, were given. In their opinion, there remained no evidence that we should treat fetuses with drugs. It is just as easy to treat this condition after pregnancy if it is not having an effect on the baby, and this was the way we felt it should be done. If women do have a continued infection, it should be treated, and it can be treated when there is no fetus at risk. This was the agreement among the investigators. I have no other detailed information to pass on.

Dr. Fomon: As a point of clarification, I was not addressing myself to the advisability of treatment or no treatment, but to whether or not the evidence that there is an association between bacteriuria and prematurity has been sufficient to exclude further study of this problem.

Dr. Terris: The point was made by Dr. Gellis, and it is a very good point, that councils can be wrong in their judgment. I did not make my evaluation on the basis of any council opinion. My judgment was made on the basis of what I thought was a very careful review of the literature. And I was not counting papers; I evaluated them—and there is quite a difference

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between counting for and against, and seeing what actually happened. Dr. Fomon, I invite you to take the 20 papers and review them carefully yourself, and then decide if you want to take the time and trouble to do another study. My advice, on the basis of what I have reviewed, is that you would be wasting your time. Most of us who have worked in this area now feel this way.

Dr. Flowers: I would take a somewhat different tack in discussing bacteriuria. Dr. Fomon has a point that I would like to move toward. Dr. Janet Fisher and I did a very careful study at the University of North Carolina that thoroughly convinced us that there was no relationship between bacteriuria and prematurity. But the fact is that lower social groups have a much higher incidence of bacteriuria. This is important. The same was true in our study of the premature rupture of membranes: greater frequency occurs in lower social groups where it is far more lethal to the baby. Why are there changes in resistance in lower social group patients? If we can answer this, we will unearth something that is extremely important in all aspects of prematurity.

Dr. Benson: Thank you for a most spirited discussion and a most illuminating Session.

SESSION IV

The Low Birth Weight Infant

Session Chairman: EDWARD WASSERMAN, M.D.

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OPENING REMARKS

Dr. Wasserman: Our fourth Session concerns the illusive "low birth weight infant." Although a review of the historical events in the development of this term is unnecessary, it is essential to clarify its varied usage. Obstetricians generally apply the term to any infant who weighs less than 2,500 grams at birth, regardless of the duration of the period of gestation.

The pediatric literature, on the other hand, is currently attempting to correlate various developmental criteria of maturity, especially anticipated weight ranges at each week of gestation, with duration of pregnancy. If the currently published charts based on relatively small numbers of infants from local populations may be universally applied, a 1,500 gram infant at 28 weeks of gestation would fall into the 90th percentile for weight and, consequently, would be considered large for gestational age. A 1,000 gram infant born after 28 weeks is premature, but appropriate in size for gestational age. In order to be both premature and low birth weight, the product of a 28-week gestational period would have to be below the 10th percentile for weight or less than 850 grams. At term, of course, the critical weight ranges about 2,500 grams. Implicit in the usage by pediatricians is that the etiology and prognosis of prematurity and low birth weight for gestation differ. It is curious that the duration of pregnancy is information gleaned by the obstetrician, but is much less acceptable as valid to him than it is to the pediatrician.

I should like to comment on the scope of the problem of the low birth weight infant. Since the subcommittee has not yet reported, and our Conference Chairman, Dr. Gold, is an obstetrician, I shall defer temporarily to his definition of low birth weight. As a group, it may be described as consisting of high risk infants. The degree of risk is clearly demonstrated by a comparison of its mortality rate with that of full-size infants. Low birth weight infants comprise about 10 percent of all live births. This 10 percent of infants accounts for about 75 percent of all neonatal deaths. At the present birth rate in the United States, somewhat in excess of 3 million per year, more than 300,000 such infants are born and, of these, about 45,000 die. There is little question that morbidity, including mental retardation, cerebral palsy, and other central nervous system deficiencies, occurs more commonly as birth weight falls. Every effort to improve these morbid results should be made. But should this be our ultimate goal? Should not the ultimate goal be to enable one to appreciate the appropriate relationship of the low birth weight infant to the total problem of mental retardation?

One of the difficulties in presenting a program of maternal and child health to medical students is to establish the essential concept of a continuum of care from mother to child from generation to generation. If the care is to be continuous, how can the interest of the physicians providing the care be

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episodic? It is this contradiction of theory and practice that confuses the student. Can we justify the obstetrician's intense interest in the nutrition of a pregnant woman during a 9-month period and his lack of concern for her nutrition during the antecedent 20 years? The pediatrician is deeply involved with monitoring the fertilized ovum as it develops, but his almost complete lack of interest in the existence of these ova for the 20 antecedent years seems shortsighted.

Some observations made at New York Medical College may be of interest. Fifty randomly selected, 7-year-old Puerto Rican males, living in the deprived area of East Harlem in New York City, were tested. Results showed that 29, or 58 percent, had a full scale IQ of under 90, and 40 of them, or 82 percent, had verbal IQ's of less than 90.

The percentage of low birth weight infants is highest in such depressed areas. Seventy-five percent of the nation's mentally retarded are produced in the low-income, disadvantaged areas. Are we to eliminate the prenatal and natal factors which cause retardation of low birth weight infants only to insure the appearance of such problems during their childhood? Are we to save these infants from one fate only for them to experience a worse one?

Do these apparently isolated and unrelated elements of improved maternity care, low birth weight, continuity of care, and socioenvironmental factors fit into a resultant unified concept? I propose, adequate funds notwithstanding, that proper maternal and infant care and prevention of mental retardation exist only as an integral part of continuous, comprehensive health care for all individuals, including fathers, and not solely by improving care during the 9-month period.

THE LOW BIRTH WEIGHT INFANT

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The subject I was asked to discuss is the low birth weight infant. Strictly speaking, this subject should not be included in a Conference entitled "National Conference for the Prevention of Mental Retardation Through Improved Maternity Care." It is clear from the nature of the Conference that we are concerned with the problems which result in the production of low birth weight infants and with the prevention of these problems. Therefore, we should not concern ourselves with the low birth weight infant himself for, if we can prevent premature birth and failure to thrive in utero, we shall, presumably, markedly lower the incidence of mental retardation which is associated with prematurity. Thus, I should examine the low birth weight infant in terms of *maternity care*, the keynote of the Conference.

The word "maternity" sent me to the dictionary to be certain of its definition. According to *Webster's Seventh New Collegiate Dictionary*, the definitions of the noun "maternity" are: "1a: the quality or state of being a mother: *motherhood*, 1b: the qualities of a mother; motherliness, 2: a hospital facility designed for the care of women before and during childbirth and for the care of newborn babies." If I adhere to these definitions, then I am free to discuss the low birth weight infant in terms of motherhood or motherliness or in terms of the physical plant which houses mother and newborn. The latter seems impractical at the moment, though it is a subject fit for discussion in terms of modern equipment, monitoring devices, etc., while the former seems more appropriate. Or am I entirely wrong in my interpretation and am supposed to discuss the low birth weight infant in terms of himself and his management?

I asked for no specific charge when receiving the title of the talk, received none, and feel free to determine the nature of my talk. I could, therefore, discuss the physical attributes, the physiology, the biochemistry, the nutrition and metabolism and the course of the low birth weight infant. Much recent work has been carried out to select from this group the high risk infant; much has been written of his caloric needs, his great tendency to hypoglycemia and to respiratory distress, his need for early feedings, etc. A review of all of these aspects appears praiseworthy but seems to violate the requirements of a Conference on improved maternity care and belongs rather to a separate conference on the peculiarities and their management of the low birth weight infant.

I shall, therefore, adhere to the strict nature of the Conference and discuss the low birth weight infant in terms of his mother. What can we discuss about the relationship between the mother and her low birth weight infant? Whatever we discuss must essentially concern mental retardation since this is what we must try to prevent. If for purposes of discussion we accept two hypotheses, we can proceed with my proposed discussion: the first is that prematurity, or low birth weight, contributes seriously to the problem of mental retardation; second, that a very important cause of mental retardation in this country is deprivation of both emotional and sensory stimulation. Can these be brought together? Essentially, what I am proposing is that our modern methods of premature care contribute nothing to improved motherliness for the infant; they actually set the stage for a poor relationship between mother and infant which, in turn, retards the physical, intellectual, and emotional development of the infant. Let us review the customary relationship.

The low birth weight infant is placed as soon as possible after birth into a glass box which he usually occupies until shortly before he is discharged. He is handled as little as possible because of our fears about exposure to infection. He is fed while inside his incubator; if he is very small, this is done by a tube passed into his stomach or by an intravenous tube into his vein. He is kept warm by electrical circuits. His breathing is aided by moist oxygen. His father peers at him through glass, and, when his mother is well enough to leave the hospial and returns to visit him, she too peers at him through glass windows. As the infant grows older and gains weight, he continues in his incubator, and only as he approaches 5 pounds in weight is he finally transferred to a crib. At this point in most newborn nurseries, he is taken from the crib and held in the nurse's arms for feedings. The interval between birth to this point is dependent on his maturity at birth and his ability to suck and gain weight. For many infants, this interval may last 4 to 6 weeks or longer during which his contact with the human voice and human touch is minimal. Just prior to discharge, his mother is allowed into the nursery in which are kept the larger prematures being readied for discharge home. Gowned, capped, and masked, she is given one or two opportunities to hold her infant, feed him, bathe him. At this point, the infant is discharged.

What is wrong with our procedure? We impress on the mothers of low birth weight infants their extreme delicateness, their susceptibility to infection, their need for highly specialized care. In actual practice, infection has played a relativley minor role in the morbidity and mortality of the low birth weight infant. We keep to a bare minimum contact between nurse and infant. Finally, we admit the mother to the nursery for a minimum of contact with her infant. She is subjected to all of this because of her failure to keep him inside her for an appropriate time. Under strict supervision and aseptic techniques, we expect her to become so familiar with this fragile infant that, a short time later, she becomes completely responsible for his care. We take an infant who, while inside his mother, is subjected for at least 14 of the 24 hours to her bodily movements and for 24 of the 24 hours to her cardiac and respiratory movements, and we place him in an isolated area without movement or contact except that which comes with his feedings, skin care, and his change of diapers. He is exposed to artificial light constantly. There is no rhythm established within his day except by feedings. How should this regimen be changed?

As soon as the critical period of adjustment of the low birth weight infant has been successfully negotiated, feedings should be given outside the incubator during which he should be held in the nurse's arms. Regularly, at other times during the day, he should be held. During the night, lights should be dimmed. As soon as his mother is able to return to the hospital, she should spend as much time as she can giving care to her infant in place of the nurse: holding him for feedings and, at many other times, giving skin care—and, at *all* such times, talking or singing to her infant. If this is her first child, she should be permitted to spend most of her day in the nursery, wearing a gown but no cap or mask. If she has other children at home, their needs will determine how long she can spend each day in the care of her low birth weight infant, but it should be as long as possible. Although her care of the infant will, at first, be closely supervised, as she grows more confident, she should be given more responsibility and turn to a nurse only when she feels the need for advice.

What arguments can be offered in favor of this change of methods? The following, at the present time, are not powerful but merely suggestive: first, the evidence which stems from foundling homes where infants are given minimal care—feedings and changes of clothing but little holding or exposure to the human voice. In such infants, lethargy, inactivity, lack of expression have been striking, accompanied by slow development and inferiority of intellectual development. As yet, the period of time from birth in which lack of stimulation is critical to development is unknown.

Next, the high incidence of emotional deprivation and lack of environmental stimulation in the failure to thrive syndrome in infancy has been noted by a number of observers. The most striking effect of such neglect has been documented in failure of gain in weight and height despite adequate nutritional intake. Such infants are noted to be extremely listless, lying in a fetal position with arms flexed. Gain in weight and height follow fairly quickly the provision of a mother substitute whose care consists solely of much holding and rocking of the infant.

In a recent survey in our hospital, 100 consecutive infants with an admission diagnosis of failure to thrive were studied. Eliminated from the series were infants who at the time of admission had, by history or physical examination, obvious explanations for their failure to thrive. Of the 100 infants accepted into the study, over 50 percent were found to have failed to thrive normally because of a distinctly abnormal relationship between infant and mother. Frequently, the mother was an alcoholic and withdrawn. Often, she was highly educated, annoyed with being home-bound, full of resentment of her infant and determined to raise him by the book, adhering to a regular schedule. In either instance, the infant was left alone for long periods of time, received little mothering, affection, or attention. With almost every infant, a mother substitute quickly altered the appearance of the infant. The listless look disappeared; the infant became alert and responsive, and weight gain began. The mother was given psychiatric help and attempts were made to assist her in understanding the basic problem. We have assembled as yet no data concerning the followup of these infants, and little has been reported in the literature. But, on the whole, I feel discouraged about the prognosis of such infants who are returned to their mothers, for I am doubtful about the success which can be achieved in altering the emotional state of the mothers. It is vital that such infants have long-term followup to determine the permanence of injury.

Other evidence for the critical importance of mothering may be found in two conditions which have long been problems in clinical pediatrics. One of these is rumination, a condition in which an infant grows and gains little owing to the frequent regurgitation of small quantities of milk from the previous feeding. These infants demonstrate constant sucking movements of their tongue and cheeks. Careful investigation of this condition has led to no evidence of organic disease. Again, this appears to be closely related to maternal deprivation and lack of environmental stimulation—and a substitute mother similarly brings it to an end. The other condition in infancy, spasmus nutans, consists of rapid head nodding accompanied by nystagmus. For years, this has been attributed to dimness of light in the infant's environment and has been likened to the nystagmus which miners, deep in dimly lit mines, are prone to develop. Again, evidence is mounting that this condition has nothing to do with adequate light, for it may be found among the infants of the well-to-do, living in brightly painted, well-lighted nurseries. Instead, it appears also to be related to lack of stimulation and develops among infants who, with lack of stimulation, turn "into themselves" for gratification. Why some infants resort to rumination while others develop spasmus nutans is not clear.

Ample evidence for the importance of a warm relationship between mother and her very young may be found in animal studies. I will mention only a few. The studies issuing from primate colonies, showing the marked emotional disturbances which develop in newborn monkeys given a wire surrogate mother to which they could not cling, have been frequently cited. Gajdusek has reported on "jumpiness in mice," a permanent nervous condition in mice separated as newborns from physical contact with the members of their litter. The period of separation needed to bring about this condition is quite brief. Sound recordings of maternal heart beat in newborn nurseries are said to be accompanied by a marked decline in crying and irritability of newborn infants.

We could go on and on with experiments and studies which indicate that the critical period of physical warmth and stimulation of the infant or young animal begins early. Relatively little information has been scientifically accumulated to show the length of this critical period and when it can, if at all, be totally reversed. Some attempts are being made to study this problem in the premature infant. We are introducing mothers of first born prematures into our nurseries as quickly as the mother is physically able to take over the management of her infant. There is little resentment on the part of the nurses to this procedure; they are delighted to have the added help. Marshall Klaus at Stanford has been experimenting with so-called "touch" and "no touch" mothers of low birth weight infants. Preliminary data from both studies suggest three conclusions: first, the improved rate of gain in infants under their mothers' care which continues following discharge from the hospital; second, a marked difference between the two groups of infants in terms of feeding difficulties and infections; third, a striking difference in the attitudes, fears, and worries in the mothers of the two groups. Of vital importance will be sufficiently large numbers of infants under study with matched controls and extensive followup to determine whether differences can be noted in motor, intellectual, and emotional development between groups.

Having developed this theme which is far from original, the question can be raised as to our present-day management of the period of pregnancy itself. This would apply to all pregnant women. The problem of emotional stress as a possible etiological factor in the production of premature birth has been discussed, but little scientific data have been accumulated. We know that the pregnant woman who is a heavy smoker produces a smaller infant than her nonsmoking control. We do not know, as yet, if these findings are the direct result on the fetus of nicotine or other agents contained in cigarettes. However, there is also the possibility that the emotional factors which underlie heavy smoking may be related.

Some time ago, I was shown a flat plate of the pelvis of a pregnant woman. The film clearly revealed the skeletal system of the fetus with its thumb firmly within its mouth. Since then, I have come across two additional fetal thumb suckers. Up until these X-rays, I had given little thought to the need of the fetus to suck nor to any of his emotional needs. Now I wonder, and others should, about the entire intrauterine existence of the fetus. We have given considerable attention to infections which traverse the placenta, to placental insufficiency and growth failure of the fetus, to congenital abnormalities and their time of development, to possible roles of diabetes, preeclampsia, toxemia, etc., in the etiology of prematurity. Should we not also be taking a much closer look at the emotional state of the pregnant woman? Is the importance of prenatal care in the reduction of prematurity or stillbirth tied in with the actual examination conducted by the physician of the woman who is coming regularly to his office or clinic? What abnormalities, illnesses, infections does he turn up by such examinations, and how often do these occur?

These questions are not being asked of the obstetrician only; the internists are querying the return, other than monetary, of their highly popularized "annual checkup." The pediatrician will freely admit that the regular and frequent examination of the young infant yields relatively little pathology after the initial examination, if properly done; the main purpose of the visits is the opportunity for the mother to discuss her problems. Perhaps this should be the main goal of obstetrical visits. This does not mean that weight, blood pressure, and urine examination should be omitted—they are usually done by the nurse—but the "laying on of the hands" should be accompanied by considerable conversation. Perhaps in this lies the chief benefit of good prenatal care—it gives the pregnant woman an opportunity to discuss her fears and worries. But does the obstetrician give her sufficient opportunity? I wonder how often he learns from his patient what her mother's attitude had been toward pregnancy and children. Does she want this child, or is she a careerist annoyed at finding herself house-bound? Presidents of women's colleges often seem determined to make their students look upon motherhood as strictly part time, something to be gotten over with, and the discontent of young mothers is increased by lectures on the obligations of female graduates to society.

What I am trying to say is that we do extremely little to help the pregnant woman enjoy her pregnancy and her motherhood; we do little to encourage breast feeding, and we do little to encourage her to express her fears. Yet, something is accomplished apparently by the little that is done. There is a whole field which has hardly been touched, namely the study of the fetus. A little is known of electrocardiography of the fetus toward the very end of pregnancy, but we are just beginning to explore the fluid which surrounds him. We know little of his activity in utero, nor the factors in the mother which affect him. We know next to nothing of the relation of her emotional state to his well-being. Just as man has only now begun to explore space and the depths of the oceans, I suggest that the world of the fetus is the third unexplored area of modern man. The possibilities are enormous and the returns may be great. We can learn all about the circadian rhythm of the infant in relation to that of the mother. We should be able to determine how maternal anger, fear, and hunger affect his physiologic state, and, in so doing, we may discover more about the factors which result in his early birth or his undernourished state. This does not require that we abandon the standard studies of maternal nutrition, blood pressure, toxemia, etc., and their relationship to the low birth weight infant. These studies should be extended to view the role of the mother's emotional state on the well-being of her unborn child.

I have stressed in my limited view of the low birth weight infant the possible importance of the emotional state of mother, both during and after pregnancy. I know that this is only one aspect of the multiplicity of problems which may be responsible for her delivery of a low birth weight infant. Many other factors have been mentioned, in particular her state of nutrition.

It is obvious that the prevention of the delivery of a low birth weight infant is dependent on many factors, most of which have been poorly studied, poorly controlled. Obstetricians, in arguing for prenatal clinics for high risk mothers, act as though the very attendance at such a clinic would make a great difference in the outcome of the pregnancy. Now I learn at this meeting that such attendance has little measurable effect. Is this because the women who attend a clinic are "educated" women, in contrast to those who register for purposes of delivery and then never show up again until they start labor? Are those who attend faithfully women who, accepting rightly or wrongly the importance of medical care, are the very ones who recognize the need for a good diet, ample rest, etc., and who thus require no such attendance? May not the importance of prenatal care lie in the involvement of the women who do not attend?

I grow increasingly annoyed at the chart which shows our place in the world in infant mortality. How can our mortality rate be compared with those of small nations with well-educated populations of one cultural background and with high nutritional standards?

I see little hope in our present efforts to lower the rate of low birth weight infants. It seems to me that success can only be achieved through the education of our low socioeconomic groups, and that this can only succeed if, simultaneously with good education for the children of our country, we improve the environment in which they live and the opportunities for their parents. I see little to be gained for the child who is exposed to good teachers, if he must return at the end of the school day to an environment of grinding poverty where there is no interest in his achievements, no support to his efforts. Only if we learn how to motivate both the child and his parents to desire good health practices can we hope to make a real impact on pregnancy and its outcome. I agree vehemently with what has already been said here: that a healthy pregnancy and a healthy infant can result only from adults who have been healthy children. This is a problem of starting with good health and maintaining it.

Finally, when I refer to good health, I mean not only physical health but emotional and intellectual health as well.

This does not mean that I suggest the abandonment of prenatal clinics. I do feel, however, that the emphasis has been on the wrong group of women —those willing to attend a clinic. Our major effort must be aimed at seeking out those who do not attend, and our success with this group can only be achieved by a total effort.

We, as physicians, cannot accomplish this alone. This involves a total commitment by our total population which must be convinced that little impact will be made on our health problems until poverty and lack of education are no longer major factors within our land.

PANEL DISCUSSION

RESPONSE

by

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Dr. Gellis has suggested that current practices in management of premature infants are likely to lead to psychosensory deprivation with resultant mental retardation. I should like to ask four questions:

1. What definition of mental retardation is most appropriate to this consideration?
2. How impressive is the evidence that mental retardation can be produced in the premature infant by neonatal "emotional deprivation"?
3. Is it correct to depict a premature nursery as an environment lacking in sensory stimulation?
4. Is the environment we imagine to be ideal for the full-size infant also appropriate for the premature infant?

A few remarks about each of these questions may help to indicate the reasons for asking them.

Definition of Mental Retardation

Most definitions of mental retardation appear to be based on the concept of subnormality in intellectual functioning without mention of whether this subnormality is transient or permanent. One definition specifically states that ". . . mental retardation is a term descriptive of the *current* status of the individual with respect to intellectual functioning and adaptive behavior. Consequently, an individual may meet the criteria of mental retardation at one time and not at another."[*] When Dr. Gellis speaks of "emotional deprivation" and lack of environmental stimulation as causes of mental retardation in the premature infant, it seems necessary to ask whether this mental retardation is permanent or transient. In the case of a transient disorder without residual effects, I should be reluctant to attempt prevention if the attempt carried with it even a small increase in mortality or morbidity from infection or other causes.

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[*] American Association on Mental Deficiency: *Manual on Terminology and Classification in Mental Retardation.* A Monograph Supplement to the American Journal of Mental Deficiency, 2nd ed., 1961.

Evidence that Mental Retardation Results from Neonatal "Emotional Deprivation"

If the mental retardation about which Dr. Gellis speaks is permanent, and if even a small percentage of it can be prevented by emotional stimulation in the neonatal period, it is clear that every possible method of prevention must be employed.

The concern expressed by Dr. Gellis over development of mental retardation because of "emotional deprivation" seems to be based largely on analogy with a situation he believes to be frequent in infants with "emotional deprivation" and failure to thrive. Dr. Gellis may have access to information as yet unpublished from his own institution which may be more convincing than published reports. From review of the literature, I find no acceptable evidence to support the belief of Dr. Gellis and many others that infants with "emotional deprivation" fail to gain in weight and height despite adequate nutritional intake. Infants with "failure to thrive" and "emotional deprivation" generally suffer also from caloric deprivation. Such infants, often with histories of large caloric intakes, gain weight in the hospital when given adequate caloric intake, even when no attempt is made to provide "mothering."

Sensory deprivation almost certainly does, at times, interfere with normal growth, even when an adequate food supply is presented to the infant. The mechanism for failure to grow under these circumstances is likely to be simple: the infant refuses much of the food that is offered. In all of our metabolic studies over the past 12 years, we have as yet failed to identify abnormalities in nutrient absorption or utilization that could be corrected by increasing the degree of sensory stimulation. Neither is there evidence for markedly increased energy expenditure by infants with sensory deprivation.

Sensory Stimulation in the Premature Nursery

If we are to make a sharp distinction between sensory deprivation and emotional deprivation, I believe I would agree with Dr. Gellis that life in a premature nursery might be associated with emotional deprivation. However, I am not at all certain that the newborn infant, premature or full-term, has achieved a stage of maturation where a distinction between sensory and emotional stimulation is germane.

I would not describe a large premature nursery as an environment in which sensory stimulation was deficient. Such nurseries are areas of high intensity care with visual and, especially, auditory stimuli greater than many full-size infants would be likely to experience in their homes. Olfactory stimuli may be impressive. Even tactile stimuli can hardly be said to be minimal since feeding, diaper changing, and changing of the infant's position are likely to take place every 2 to 3 hours. Perhaps body temperature and apical heart rate will be recorded at 4 hourly intervals. Often, the infant will be bathed and weighed each day. Not infrequently, he is examined by a physician, a blood count is performed by a laboratory technician, or he is subjected to some other procedure. Premature nurseries differ from one another greatly, but many are rich in sensory stimuli.

Appropriate Environment for the Premature Infant

Unfortunately, we do not know whether we should attempt to create for the premature infant an environment as similar as possible to that which he would be experiencing in utero had he remained there for the allotted time, or one as similar as possible to our preconceived notion about the ideal home environment of the full-size infant. In the first instance, we would want the infant to remain tightly wrapped, his temperature precisely controlled, his food metered in without interruption (probably by vein), as little light as possible day and night, and the human voice muffled as we suppose it might sound to the fetus. We might wish a recording of the human heart beat to be audible to the infant at all times, and we should like to have him constantly and gently rocked to a rhythm suggesting adult respiration. In addition, he should be joggled irregularly, sometimes roughly, during at least 14 hours of the day in a manner that would simulate his mother's movements as she performed household chores and other activities. Such management would not be wholly lacking in theoretic justification, but makes me hesitate before rushing to accept Dr. Gellis' suggestion that the small premature infant be treated as much as possible like the full-size newborn.

Not only is there an appreciable risk of infection, but the absence of a substantial subcutaneous layer of adipose tissue makes the small premature infant susceptible to wide swings in body temperature when his environmental temperature is not rigidly controlled. Whether the metabolic effects of such temperature fluctuations might cause damage to the brain or to various organs is unknown.

RESPONSE
by

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Because I am a pathologist I cannot discuss the subject of Dr. Gellis' presentation, but perhaps I can complement it by a consideration of the biologic background of low birth weight.

Variations of fetal growth during the third trimester of pregnancy are illustrated in Figure 1. This figure is based on birth weight curves, since we obviously cannot obtain true growth curves of normally living fetuses weighed and measured at regular intervals. During the early part of the third trimester, birth weight curves of most populations investigated fall within one narrow area (near line E in Figure 1), after proper correction.[1] There are reasons to believe that the straight line extrapolated from growth data during this period indicates the manner in which the fetus would continue to grow if it were optimally supplied.[1,2] However, at some time during the last month before term (or earlier under extreme conditions), the curve of each population departs from this straight-line course. This presumably occurs shortly after growth support received from the mother via the placenta becomes insufficient to allow full realization of the growth potential. The more limited the supply line is, the earlier the departure from the straight-line curve and the lower the weight at term. Figure 1 shows a Swedish curve as the one with the latest known departure from the extrapolated curve; then the usual one found in many Western populations, and the one from Denver which is somewhat lower perhaps owing to altitude (this is shown because these data of Lubchenco et al. are frequently used as standards). The two curves from Japan illustrate the striking effect of changing socioeconomic circumstances on fetal growth of a population in less than 20 years. Finally, twins are shown as a severely growth-retarded group.

To return to infants of low birth weight, most of the studies reported in the past have failed to distinguish preterm from growth-retarded small infants. I do not need to explain why this has retarded progress and why it must be changed. The immediate complications of preterm birth are well enough known: general inability to adjust to extrauterine life and, more specifically, respiratory distress, hyperbilirubinemia, and failure to maintain op-

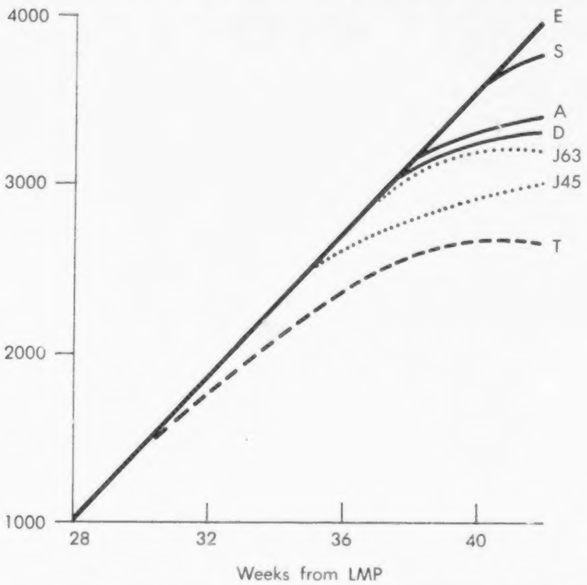

FIGURE 1. Approximate birth weight curves to illustrate departure from the extrapolated curve (E) at various points in time, resulting in different weights at term. S Swedish (Lindell[9]); A the usual American (Baltimore, Gruenwald[1]); Denver (Lubchenco et al.[10]); J63 and J45 Japanese from 1963–64 and 1945–46 (Gruenwald et al.[7]); and twin data (British Perinatal Mortality Survey).

timal body temperature. The characteristics of the growth-retarded neonate have only recently emerged. While in this group the just mentioned difficulties of the preterm infant are of little importance, there is hypoglycemia with its inherent danger of brain damage, and continued growth retardation. Concerning brain damage in survivors, there is indication that this, too, differs in the two groups as might be expected in view of the great differences in prenatal and perinatal circumstances. We need to follow up infants of low birth weight with a full appreciation of these circumstances in order to learn which of the cerebral sequelae of low birth weight stem from preterm birth and which from intrauterine deprivation. It will only be when children observed in today's and tomorrow's best newborn services grow up that we will learn to disentangle the contributions of true prematurity, asphyxia, hyperbilirubinemia, hypoglycemia, intrauterine deprivation, and other perinatal factors to brain damage.

Severe growth retardation of the fetus occurs sporadically in all populations. In order to define this group, arbitrary standards have been set at either the 10th percentile or 2 standard deviations below the mean for the respective week of gestation; the former includes more than three times as many cases as the latter. In these cases, we have indiscriminately spoken of "placental insufficiency" as a cause. Now we are learning that the mother's organism is often at fault[3] rather than the placenta which is a fetal organ. There are cases of true placental insufficiency to be sure, but the role of the maternal organism needs to be investigated in much more detail. Maternal circulatory factors probably play a great role.[4,5]

Growth retardation is detectable by the above mentioned arbitrary standards only when it reaches considerable degrees. This requires deprivation of several weeks' duration: chronic fetal distress.[6] Since this process starts before the fetus has acquired much subcutaneous fat tissue, no wasting can occur, and the external body proportions are, therefore, very similar to those of preterm infants of similar weight. In contrast, subacute fetal distress,[6] occurring shortly before birth and lasting several days (presumably less than 2 weeks), leads to wasting in infants who had developed normally until shortly before term. This results in the conspicuously long thin baby, usually above the arbitrary limits of growth retardation. In contrast to body weight, structural and functional maturation is little, if at all, affected by chronic fetal distress as is well known to those caring for these infants.

Malformed fetuses are frequently retarded in growth, but owing to a reduced growth potential rather than deprivation.[6] They are not included in the present considerations.

In contrast to these sporadic cases of outright pathologic growth retardation, moderately subnormal fetal growth frequently occurs. As a result, the incidence of low birth weight varies among populations, and among groups of pregnancies with certain medical or sociological characteristics. It is now virtually certain that much of what was once attributed to racial characteristics is, in fact, socioeconomic, and that so-called prematurity rates may reflect slow intrauterine growth rather than short duration of pregnancy. This became strikingly apparent in a study (which I initiated in Japan) of birth weight in relation to gestational age during a 20-year period.[7] In 1963–64, fetal growth was considerably more rapid than in 1945–46 (Figure 1); during the intervening period, the highest prewar mean birth weight has been surpassed, but gestational ages were, if anything, slightly shorter. Thus, fetal growth is a sensitive indicator of socioeconomic change. Yet this short-term effect should not let us forget that any woman who, herself, grew up under unfavorable conditions in utero and during her childhood, and who may manifest this among other traits by her short stature, will never be an optimal reproducer no matter how well cared for and nourished she is when she becomes pregnant. Improved conditions may well take two or more generations to manifest themselves by optimal support of fetal growth to the full extent. There is no evidence that moderate suboptimal growth of populations, as was just discussed, causes brain damage, although this might occur when effects are severe or multiple. In order to apply help where it is most effective, we must learn just what it is in a poor socioeconomic environment that effects the fetus via the mother.

In certain ranges of birth weight, growth retardation is less detrimental to the fetus and neonate than preterm birth, and this presumably accounts for the observation that in low social classes, mortality is not increased in proportion to the rate of low birth weight. However, this is not uniformly true.

Butler and Bonham[8] have shown that in the weight group of 1,500 to 2,000 grams, the mortality of growth-retarded infants born after 37 weeks of gestation is higher than that of babies born earlier in pregnancy.

In summary, we must learn how to evaluate the interaction of time (gestational age) with quantitative changes (growth) and qualitative development (maturation) during normal and abnormal fetal life. This sets the stage for the manner in which a given neonate is affected by, and reacts to, the birth process and to its new extrauterine environment. While this interplay affects the entire organism, it has the most significant permanent effects on the central nervous system which is least amenable to restitution following damage.

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RESPONSE
by

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I would like to quote some of the work done by Herbert C. Miller and Prasit Futrakul of the University of Kansas Medical Center on "Respiratory Distress Syndrome in Infants of Low Birth Weight by Determining Bone Age."

> "Bone age, calculated gestational age, birth weight, body length and head circumference were determined on all infants born at the University of Kansas Medical Center since July 1967 who weighed 2,500 grams or less at birth. There were 97 such infants; 23 of these were not included in the present results because permission to make roentgen studies of their knees was not obtained. Birth weights were determined at birth; the other parameters were evaluated on the third day after birth or before death. RDS was diagnosed if the infant had generalized cyanosis or duskiness in room air and had either an expiratory grunt, severe thoracic retractions or a respiratory rate exceeding 65 per minute on more than one observation between 1 and 24 hours after birth. The presence or absence of ossification centers in the knee appeared to be the best of these parametes for predicting RDS. Determining bone age immediately after birth or just before birth in elective deliveries may be useful in predicting RDS among infants of low birth weight or suspected low birth weight." (See page 173 for statistical data.)

In response to the statements made by Dr. Gellis, I believe he has very aptly covered some of the problems relating to the low birth weight infants; I think others have been missed. Reference to the effect of poverty of the mother and father and the social class of the mother and maternal grandfather on the increased incidence of low birth weight infants should have been called to our attention. I refer specifically to the work of Mary Drillien of the University of Edinburgh and to Sir Dougald Baird at the University of Aberdeen. There seems to be a great deal of documentation that poverty does increase the incidence of low birth weight infants. Dr. Drillien's data show that the social class of the baby's maternal grandfather is better correlated with premature birth than the social class of the mother's husband. She also shows that the husband's social class is a more relative measure of liability of premature birth than his actual earnings. Also, she shows that the mother's height is a better index of premature birth than the husband's social class or earnings.

Ossification Centers		*None*	*Distal femoral*		*Distal femoral + prox. tibial*
Total infants		22	36		6
Infants c̄ RDS		9	0		1
Calculated gest. age—wks	*under 30*	*30–33*	*34–37*	*over 37*	*?*
Total infants	3	12	25	28	6
Infants c̄ RDS	2	3	3	1	1
Birth weight gms.	*1251 to 1500*	*1501 to 1750*	*1751 to 2000*	*2001 to 2250*	*2251 to 2500*
Total infants	1	6	17	15	35
Infants c̄ RDS	1	3	2	3	1
Body length cm.	*not done*	*under 42*	*42–43*	*44–45*	*over 45*
Total infants	1	5	13	28	27
Infants c̄ RDS	1	1	2	5	1
Head circ. cm.	*not done*	*under 30*	*30–31*	*32–33*	*34–35*
Total infants	1	7	28	31	7
Infants c̄ RDS	1	3	4	1	1

Considerable work has been done to show that premature birth or low birth weight infants are more likely to occur among short mothers than among tall. It is my understanding, from the research done by Raiha in Finland on the premature birth in women with small hearts, that women with small hearts tend to be short in stature, and, perhaps, this may be a significant parameter.

I am very much impressed that Dr. Gellis has given a great deal of stress to the care of the premature baby after birth and the lack of human contacts during this period. I agree—as our own pediatricians at the University of Kansas would agree—that this could be a significant potential risk; however, its exact role has yet to be determined. Other factors should be considered; for instance, heavy smoking, as demonstrated by the work at the University of Indiana showing a correlation to the volume of blood flow through the uterus in animals that are smoking. Could this explain the further studies showing that excessive smoking in the mother during the first trimester is significant enough to reduce the birth weight of the infant at term? We are not minimizing the emotional factors; there is no question they are significant and probably play a role in the problem.

Another factor in the emotional aspects that has not been discussed is the relationship of the unwed mother to low birth weight infants as well as the incidence of congenital malformations in individual youngsters of low birth weight. Dr. Drillien has data that show a high incidence of severe emotional distress (such as from death and divorce) in pregnancies of mothers of low birth weight infants of the very lowest order, and that these infants also have a high incidence of congenital malformation. She seriously believes that some of these malformations may be induced by the tremendous emotional distress of the mothers.

Many factors play a role. I believe a great deal of effort must be aimed in the direction of more fundamental studies in nidation and implantation, first trimester of pregnancy, and in the study of the placenta as a transfer organism in the term mother.

RESPONSE
by

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Fetal and Maternal Monitoring

Dr. Gellis' presentation is a very stimulating and thought-provoking approach to an old but urgent problem. For many years, we have centered our concern for fetal environment around the purely physical aspects of the mother's body, such as weight gain, blood pressure, diet, and physical activity. Only recently have we begun to realize that the outcome of a physically normal pregnancy may be influenced by many other environmental factors, such as social environment, emotional and mental problems, pregnancy rejection, and the many other social and economic stresses that are constantly pounding upon the strained mental and emotional stability of the pregnant mother. The midwife of years past warned her patient against emotional and mental upsets, severe frights, and disturbing events. But we physicians have tabooed this approach, thinking it of little consequence. Perhaps it is time we reconsidered our attitude.

Many unknown factors are at work in the creation of problems such as premature labor and delivery. This is evidenced by the fact that in clinics for low socioeconomic patients, prematurity is not substantially reduced by longer and more watchful prenatal care, at least when only the physical needs of the patient are improved.

Too often, we have thought of the placenta as being a barrier between mother and infant, preventing the transport to the infant of harmful stimuli, whether physical or otherwise. In reality, we should think of this organ as a communication between mother and infant by which the infant receives its physical needs for growth and development, and through which other stimuli may also be transmitted. Kerr's work has shown that certain chemical structures when taken in by the maternal organism may be concentrated by the placenta, and that higher blood levels are sometimes found in the infant than in the mother. In certain instances, this can result in retardation and delayed fetal development.

Early in Dr. Gellis' discussion, he referred to motherhood or motherliness in terms of the physical equipment involved in maternity care, such as hospital facilities and monitoring devices. This he dismissed and chose to concentrate his remarks on the various psychological and emotional stimuli related to growth and development of the infant or fetus. Although a discussion of these physical devices related to maternal care is less glamorous than the psychological and emotional aspects of pregnancy and fetal development, I feel that these physical controls are of vital importance in considering the well-being of the fetus in utero and, in many instances, the outcome of the infant as to prematurity and mental retardation. It is to this part of maternal care that I would like to direct most of my remarks.

Hospital emergency rooms and intensive care units throughout the nation are crowded with expensive electronic devices for the purpose of monitoring every physical and biological movement of the acutely ill patient. A skipped heartbeat of a 90-year-old patient being monitored by this sophisticated equipment alerts the attending physician and nurse by clanging bells and flashing lights, in many instances to the hopeless task of trying to maintain life in an individual who has already exceeded his useful years and whose potential to society is almost nil. But in our maternity wards, a young mother enters in early labor carrying within her protective body the potential of many years of useful and active thinking and activity, and all it receives is a quick check with a fetoscope to be sure that the heart sounds are present. Yet we are painfully aware that an infant, during the process of birth, may become anoxic or depressed and lose its only chance for normal development and, occasionally, may die in utero because we have neglected to make any attempt to communicate with this human being in order to ascertain its needs and problems during this very crucial part of its short existence. Admittedly, it is difficult to establish a meaningful communication with an infant so encased in a fluid surrounding it as in the maternal uterus. However, little attempt has been made to cross this barrier and establish communication. The recent development of fetal electrocardiography, the electronic monitoring of fetal heart rate, and the determinations of blood chemistries from scalp punctures through the dilated cervix have been major steps in this direction. Little effort, however, has been made to facilitate the use of these tests except in a research setting and almost never as a routine procedure. Fortunately, the full-term healthy infant does not usually encounter difficulties that it cannot cope with during this vital part of its existence, and the majority of these infants turn out to be fairly healthy normal citizens. But the premature infant, being delivered before its natural resources have developed to the point of adequate protection, stands much less chance of weathering the storm of delivery, especially when it already has two strikes against it just from its premature state.

In other instances where it is necessary to induce labor at an early date to prevent an even more serious outcome as a result of maternal disease, it is imperative to know at what point an infant may be delivered sufficiently mature to develop in a normal manner. In such cases, it would be particularly helpful to know early in pregnancy, before the problem is grossly obvious, that the fetus is in trouble as evidenced by retarded growth in utero. Yet, in the past we have had no accurate method of measuring the maturity of an infant, determining its weight and size at a specific point in pregnancy, or detecting failure of the fetus to develop normally. Although physical and chemical tests can evaluate in great detail such body structures as the heart, liver, kidneys—indeed, all the vital organs—yet we have so far been unable to make adequate and rational judgment on the nature and well-being of this complex human structure within the uterus. It is so near, and yet so far.

Current investigative work has demonstrated that with ultrasonic Doppler equipment, it is possible to continuously monitor the heart sounds of the infant in utero throughout labor. Although this is very low intensity, high frequency ultrasound, supposedly causing no damage to the maternal or fetal organism, further investigative work must be done on its toxicity, since this is continuous ultrasound in contrast to pulsed ultrasound which has been used for diagnostic procedures for a number of years with no evidence of immediate or latent toxicity. This method should be superior to existing electronic methods that require rupturing the membranes so that scalp leads can be applied. Other means of fetal communication during labor must be investigated so that ultimately we will be able to know within a few seconds when fetal life and well-being are in jeopardy. With the ultrasonic Doppler instrument, it is also possible to monitor the fetal heart sounds as early as the 10th week of gestation.

By the use of diagnostic ultrasound, we can now follow at regular intervals the development of the fetus from the 8th week of gestation to term. By this method, it is possible to determine the location of the placenta and follow its development, measure the contour and size of the fetal head and thorax, estimate within approximately 2 weeks the actual gestational age of the fetus, and determine within approximately one-half pound the actual weight of the fetus at a given time in pregnancy. This can be done repeatedly throughout pregnancy when indicated. To date, no immediate or latent damage to the fetus or mother has been demonstrated by this procedure. Multiple gestation can be detected as early as the 10th week of pregnancy, giving the obstetrician an opportunity to plan for the potential complications. The low lying placenta and placenta previa can be detected in the early months of pregnancy and, again, the obstetrician can be alert to the potential dangers associated with such a condition.

Since the infant maintains its lifeline through the circulatory system of the mother, events in the mother's physiology and her physical reactions are also important in the outcome of the fetus. Therefore, monitoring devices to determine vital activities within the mother also need to be developed. Her oxygen levels are vital to the oxygen levels of the infant. Blood pressure and circulatory changes are important in predicting fetal needs before they become apparent. Uterine contractions which, of course, are important in the expulsion of the fetus, can be damaging to the infant when prolonged and unduly intense. Simple devices for the detection of these changes in the mother are currently available but are not being utilized to the extent that they are in other fields of medicine. The measurement of cervical dilatation by the crude method of digital rectal and vaginal examination is inadequate and, in many instances, detrimental. More accurate methods of determining these physical phenomena should be developed so that the time and conditions of delivery can be more accurately determined and accidents, such as precipitous and uncontrolled delivery with its potential danger to the infant, can be eliminated. This is especially important to the premature infant who is more liable to anoxia and brain damage.

The cost of such monitoring equipment, of course, is high, especially in its developmental period. But when we consider the cost of caring for just one retarded child for its lifetime, to say nothing of the human suffering and grief involved, this is a very small price to pay.

Although we are late in our efforts to make more meaningful communication with the fetus in utero, there is some light upon the horizon. I hope that within the relatively near future, we can use monitoring devices in pregnancy and labor to detect problems and, in many instances, to correct them before fetal retardation or death occurs.

GENERAL DISCUSSION

Dr. Wasserman: Dr. Gellis' position paper and the responses to it have raised a number of propositions which should be discussed further. The need for considered contemplation and the direction for appropriate action, as indicated by the respective discussants, have supported several observations reported by the President's Commission on Mental Retardation.

First, "Knowledge resulting from scientific research now makes it possible to prevent a tantalizing one or two percent of mental retardation through tests and treatment beginning at or shortly after birth (phenylketonuria and some other conditions in which metabolic disorder can produce retardation) and through immunization (measles).

"It is imperative that many more scientists engage in studies in areas (such as biochemistry, physiology, learning) related to or bearing on the field of mental retardation, and that these scientists multiply their own efforts through greatly expanded training activities for scientific researchers and supporting research personnel."

Secondly, "Biomedical research has been able to identify 25 of every 100 cases of mental retardation as associated with faulty genetic constitution or resulting from virus infections, accidents and diseases before birth or in early infancy. The body processes bringing about mental retardation in the other 75 percent of cases are still unknown, although nutritional, intellectual and cultural-environmental factors are often clearly at work." Also apparent is that we feel further studies should be made to understand the sensory and emotional environment of the fetus and newborn as well as the older child.

I should like to start the discussion by making two specific comments. Dr. Fomon has called for a definition of mental retardation, especially the temporal aspect. The term "mental retardation" does have the connotation of permanency and, consequently, a more apt term might be "learning disability." This, in light of general acceptance of remedial services, provides a more realistic solution to the problem of "temporary or permanent" effects. Society accepts that learning disabilities can be overcome. The label "mental retardation" is usually lost only by the dissociation of the retarded individual from the very groups that can offer him the most help, and by becoming lost in the mass of society, frequently swelling the welfare rolls of urban populations.

Dr. Tompkins: One subject has yet to be mentioned. I would like to ask Dr. Apgar to comment on the hazards of the period of anesthesia and its potential effects on the problem we are discussing in this Session.

Dr. Apgar: I believe that in proper hands, there is no relation of anesthesia to mental retardation. A comment was made that a few babies died during the intrapartum period. It should be on the record that in counting several hospitals, including Sloane, one-quarter of the stillbirths over 500 grams died in the intrapartum period. Monitoring is very important. In regard to anesthesia, the hazard of overdepression, which is still occurring in certain parts of this country, should be immediately corrected by ventilation —intermittant positive pressure breathing by any device. That is all that is needed.

Another hazard exists which we do not realize as much as we should; that is, more monitoring should be done of the maternal arterial pressure during labor and delivery. Hypertension from the increasing number of regional blocks is probably a bigger or as big a hazard as hypoventilation from general anesthetic agents. We need to pay much more attention to *hypotension* as a cause of mental retardation after birth.

Dr. Gold: I am pleased that question was asked of Dr. Apgar and that she answered it as she did in her first sentence—that in good hands, there is no hazard. It is the question of the competence of the anesthesiologist in relation to the anesthesia that gives us either security or damage as the end result.

Dr. Krantz: By using oxygen in the extra corporeal circulation apparatus in our laboratory, we found that high saturations of oxygen in the maternal system and in the intervillous space caused changes in the vascular supply in the placenta, such as spasm in the vessels with rupture and intermixing of the blood. Going to the delivery room and putting a positive pressure mask on the mother, which is not uncommon in our community, we found that by monitoring her blood we could pick up fetal red cells in her circulation, and, if we were not careful, some sick youngsters resulted. Therefore, it may not be anesthesia, but anything that is put on the mother's face.

Dr. Gellis: I would like to emphasize that some of the areas about which I was speaking—areas for investigation along the lines set down very firmly at the beginning of our Conference—need to be very carefully studied and controlled. Just as the obstetrician has so openmindedly decided that prenatal care needs complete review and consideration, I suggest that the emotional status of the mother, before, during, and after pregnancy, and the routine care which we now give to the newborn infant, particularly the premature, are areas in which a great deal of careful study must be carried out. We have no more reason to be satisfied with the approach that we are taking as pediatricians than the obstetricians are satisfied with their approach.

Dr. Fomon raised the question about mental retardation in terms of emotional deprivation and whether this retardation is temporary or permanent.

Very little information is available as yet. Evidence seems to be increasing that much of what has been called mental retardation in low economic groups is not truly mental retardation, but failure to function at one's full potential on the basis of a lack during the early years of growth of emotional and sensory stimulation in the environment. Many people who, in the past, claimed that certain groups within our population have low intelligence on an inherited or genetically determined basis are beginning to be convinced that, given the same background, stimulation, and interest, these groups are just as capable of functioning at a high intelligence level as those who come from better economically situated backgrounds.

The followup of the emotionally and sensory deprived child is very limited. I know of one published study, by the Hopkins' group, in which the followup showed very poor functioning at both emotional and intellectual levels when there was emotional deprivation early in life. The concept that more mothering is important to the young infant, as far as his ability to function in relatively early life, is a new one. For a long time, everyone accepted deprivation in institutionalized children as playing a major role in their low level of functioning, but relating this to a family situation has been, I believe, relatively recent. My argument is this: we do not know just when such deprivation in life is important. We do not know how early deprivation may play a role in the subsequent functioning, emotionally and intellectually, of the child. To attribute to the human what is observed in animals is unfair. But the studies that are appearing, and have appeared, in terms of deprivation in various animal species, cannot be set aside on the basis that they are being carried out in animal species. Similar studies must be carried out in the human before we can conclude that deprivation, with its long-term effects, applies only to various animal species and is not applicable to humans. I offer no proof of anything I have to propose. I suspect it would be relatively easy to determine how the group of "touch mothers" for premature infants benefit by this particular approach. It would be extremely difficult to prove how the infants might benefit by this approach.

Various people in this country are trying to carry out long-term studies on the effects of asymptomatic hypoglycemia in the newborn infant; the methods and the followup required for such proof are formidable. To carry out such studies satisfactorily is almost impossible. Thus, it may be very difficult to lend proof to what I propose. All I do ask is that we look with a fresh eye at old practices and see if we can prove, or disprove, if they play any important role.

I thoroughly agree with Dr. Fomon that in the failure-to-thrive child, caloric deprivation may play a very major part. Even so, this continues to be a problem of emotional status of the mother and her relationship to the infant. Whether this is true emotional deprivation or purely caloric deprivation, in both instances the mother's psychological status lies at the root of the problem.

I am not inclined to equate what goes on in a premature nursery in the form of sensory stimulation with the kind of stimulation which I talk about, namely the actual warmth of a mother holding her baby. I also agree that in terms of benefit to the infant, it is not necessary that this be done by the mother herself. A good mother substitute can do this, but I suspect it would be of great benefit to the mother as well as to her infant if this sensory input comes from the mother herself. I agree with Dr. Krantz that there may be in unwed mothers a tremendous component of emotional difficulties which may play a role. Here, again, is a very important area for investigation.

Dr. Wasserman: I am not sure I can support Dr. Gellis, but I did review the literature on many of the animal experiments and culled six conclusions. It might be worthwhile to review them. The greatest harm occurring following sensory or emotional deprivation occurs when such deprivation takes place over a critical period beginning soon after birth. For deprivation to have an effect lasting into adulthood, it must continue over a varying period of time, rather than occurring as an isolated incidence. Noxious stimuli are less harmful than deprivation. Deprivation need not be a total absence of contact but may be lack of patterning. Parenthetically, and Dr. Gellis referred to this, some of the procedures Dr. Fomon listed as contacts with the infant in the isolettes are more properly classified as noxious stimuli. Deprivation may result in organic changes which interfere with future development. In addition, Harlow's studies on the rhesus monkey showed that the mother-child relationship is certainly an important one, but the social interaction with playmates is the sine qua non for social adjustment. Lastly, mothers who as infants were deprived of proper mothering reject or even destroy their infants.

Dr. Stone: Some evidence does exist that warm mothering is important. Not only must this be warm mothering, but there seems to be some evidence that it matters whether it is the left arm or the right in which the mother holds her baby. Originally, it was thought the mother held the baby in the left arm for the simple mechanical reason that most people are right-handed; by holding the baby in the left arm, the right hand remained free to feed the baby. The more recent suggestion is that holding the baby in the left arm allows the infant to still be close to the maternal heartbeat, thus having the security this gives. This has been translated into the security some people receive when they tap on the table with some kind of rhythm, or by bouncing their leg up and down, or that lecturers get by rocking back and forth. Thus, there seems to be some evidence to support Dr. Gellis. I cannot say, as did Dr. Benirschke, that my source is *Science*, but my source is what I consider an excellent scientific treatise, *The Naked Ape* by Desmond Morris.

Dr. Benirschke: I would like to add something that is not very widely known as yet. There are no studies which allow one to quantitate some aspects of cerebral development. Such studies, I believe, would make it possible in the future to quantitate more adequately what is now a difficult area to assess—the central nervous system development. This we judge by psychological tests which are, at best, difficult, or by IQ determinations which are very often criticized. Also, it has been shown recently, from several sources as well as from my laboratories, that animals have a very specific growth pattern of synaptogenesis and dendritigenesis in various layers of the brain, postnatally, at very specific times, which are coincident with exactly the same timing in human neonatal development. These studies are early. They show very good concordance, despite the lack of communication between these centers.

Dr. Krantz: We all remember Newman's studies on identical twins in which he showed the significant role played by deprivation that occurs after birth. Also, there is an interesting group you may not be aware of. There are 156 chimpanzees at Holloman Air Force Base in New Mexico. They are bred in captivity and come into the world rather premature. Those that have been given very careful help by being taken into homes (one has been kept in a doctor's home for 15 months) now refuse to join the other chimps. Among them are two that will not walk on all fours. They are chimps—there is no question about that—but they have had social pattern change: they are more intelligent; they keep themselves clean; they have human toilet habits; they isolate themselves from the rest of the chimpanzees. This is all due to very careful nurturing of the individual, by giving a tremendous amount of affection from the time of birth. These chimpanzees are available for studies.

Dr. Giannini: I want to support some of the statements made by Dr. Gellis. I believe it is appropriate to say that since we are aware that cultural deprivation is such a significant factor in the lives of the retarded, it is just as appropriate to point out that early casefinding is very important, whether the problem is in terms of organicity or pseudoretardation or cultural deprivation. It is especially important in the youngster who is culturally deprived because, if discovered too late, there is a certain factor of irreversibility. All kinds of therapy can be applied to this youngster, but there is a point of no return.

In regard to what Dr. Gruenwald said, perhaps we should go into what happens to the mother during conception, or look into her background. Much of what we are talking about today will, I believe, come to the fore and be illuminated when we know more about DNA and what the genetic factors are that are inherited.

Dr. Jacobson: My comment concerns Dr. Gruenwald's presentation of the linear growth curve on his babies in relation to what Dr. Thompson says. We do have a very crude method of measuring the growth of the fetus, and this is by the weight of the mother. But the weight, by itself, has no meaning unless we also have intake. This is one of the reasons that the use of weight in determining growth has fallen by the wayside. More importantly, teaching films are currently available which recommend a total weight gain of 14 lbs. We know that in healthy women who have healthy pregnancies, the mean or average weight gain is about 27 lbs., at least in clinic patients. This is something that is forgotten, or isn't used, or certainly isn't related to people's food intake.

Dr. Gruenwald: Long ago, it was stated that if a pregnant woman ceases to gain weight or even begins to lose weight, she should deliver shortly thereafter; it is bad if she doesn't. This, of course, does not refer to a woman who is put on a diet or given diuretics. I question whether, if a woman starts her pregnancy grossly overweight, this is the right time to make her lose a great deal of weight.

Dr. Jacobson: I would like to answer Dr. Gruenwald because I was involved in a study that dealt with weight reduction during pregnancy. It is true that you can do this, if you have very high quality nutritional support. In our study, we never did prove that it was either necessary or desirable. This remains an open question.

Dr. Gold: In regard to that question, Hytten has pointed out, from experiences in World War II, that where there is an acute nutritional deprivation immediately preceding or during the pregnancy, it has relatively little effect on the outcome of pregnancy from the point of view of weight of the fetus. Where there has been a chronic nutritional defect, long antedating the period of conception, there is a very profound effect on the median birth weight of the offspring, at any date of gestation. This was supported by the information that came out of Holland where the nutritional status of mothers was excellent prior to the blitz by the Nazis, and the subsequent siege was of very short duration as far as nutritional deprivation was concerned. In contrast was what happened at Stalingrad where, for a long period of years prior to the war, chronic nutritional deprivation existed. The additive effect of the acute famine during the war was exhibited by a very profound effect on the fetus.

Dr. Stone: Dr. Gold, during our Conference Sessions, a current theme has emerged: objective people lose their objectivity when confronted with one subject—nutrition. Dr. Wallace is sure that nutrition is important. Dr. Terris is convinced that nutrition is important. Yet no one has told me how we decide who is deprived; what our parameters are; what the norm is; what we are using as criteria for nutritional deprivation. What is it we should be doing?

Dr. Gold: One of the reasons for repetitively bringing up the subject of nutrition is the total gap in our knowledge, quantitatively, about the nutritional background of the individual—its lifetime additive effects. There has been very little scientific endeavor in the laboratory to give background information to the obstetrician and the pediatrician as far as certain nutritional components of our body are concerned. Only from this type of quantitative work can we actually begin to be practical in the course of rendering antepartum, interconceptional, and child health and development care. One of the recommendations I hope to see emerge from this assemblage is the appeal for the development of such studies in order that we will have some tangible information in the immediate future.

Dr. Brown: For a good experiment, come to the back cotton patches of Arkansas where the people eat no meat at all for years on end. Maybe there's some fat back, corn, and a little bit of pot liquor. This is real nutritional deprivation, and a look clearly shows the effect on reproduction. What you are talking about is the difference between a highly sophisticated urban diet and an ideal diet, and you will probably never show any significant statistical difference from that. But come and see some really deprived diets; you will have no trouble finding the answer.

Dr. Tompkins: We have as a guest Miss Dorothy Wiehl who has had lifelong experience in the area we are presently discussing. Miss Wiehl, would you please give us a few suggestions, and some of the hazards involved, in trying to approach this problem on a definitive basis.

Miss Wiehl: Although I did not come prepared to discuss nutrition, my thinking about it is that nutrition in the human has been approached as an expectation of some specific, individual, one-to-one relationship. The feeling has been that you can take a diet history and analyze that diet in terms of calories and nutrient content and expect to find, at a given proposed level of requirement, that the patient would, or would not, be in adequate nutritional status. I have not found this to be so. When you take a diet history, you are getting a person's quantitative report of what she thinks she ate and how it was prepared. Then, you must convert this into nutrients from average tables which are built up quite properly from data of samples of food prepared in various ways. But, as applied to what this particular person ate, it may be a far cry from the actual nutrients that she received. The individual you are concerned with is not necessarily the average person for which this requirement was drawn up. Thus, we expect to see a correlation between diet and nutrition. This has been the approach in most studies—to take diet histories, compute protein content of a diet, distribute the persons over the quantitative amount of protein, and then relate this to the outcome of pregnancy or whatever is being studied. Factually, in relating any correlation or individual relationship, the greater the error in the observed value, the less likely you are to get any correlation whatsoever.

Dr. Terris: I would like to continue this line of discussion. We have to realize that pregnancy is one area in which it is easy to carry on epidemiologic experiments. It takes only 9 months for the birth of a child. It is not, for example, like the National Diet Heart Studies which take some 5 to 10 years before there is an answer. With regard to pregnancy outcome, we can have an answer in 1 or 2 years. I would like to suggest that we take very seriously the three suggestions made by Dr. Flowers—that there be experimental studies with case and control groups: one in the area of rest and the use of homemaker services; one related to shelter care for illegitimates; and the third in the area of nutrition.

This is not a new idea. I recall that in 1963 at the Chapel Hill meeting, the question was raised that we should go to such a place as Arkansas where there is a deprived population and set up an experiment on a randomized basis as to how much of the supplement is actually taken, and so on. We should seriously think in terms of doing this kind of experiment. The Children's Bureau should support this kind of experimental research. I believe we cannot obtain the answers to the kinds of problems that have been raised by doing observational studies.

Dr. Gold: Other parameters of nutritional deprivation prevail in addition to the protein element. Quite recently, we at New York Medical College have been investigating folate deficiency. Dr. Stone, would you comment on this.

Dr. Stone: I do not want to go into the details of this investigation because they have recently been published. But I will say that the incidence of folic acid deficiency is higher than originally supposed; also, that an association appears to exist between defective folate metabolism and some complications of pregnancy. We are not prepared to say it is the specific cause of abruption of the placenta, but it seems to be significant.

Dr. Fomon: I would like to comment on Dr. Stone's question: what can we do to measure nutritional status? There is the broad approach which is practical in a large group of individuals, and there are two sources I would recommend. One is the *ICNND Manual* (Interdepartmental Committee on Nutrition for National Defense) which is used for surveys in quite a number of countries and is now the basis on which a combined HEW-supported study is being carried out in the United States. Dr. Arnold Schaefer, who has previously done surveys in a number of countries, is directing this study. In addition, the Children's Bureau has published *Suggested Guidelines for Evaluation of the Nutritional Status of Preschool Children*. The same measurements, with only slight modifications in the interpretation of results, would be suitable for pregnant women. However, if one wants to look more precisely at specific minor differences, then these gross, broad, rather crude screening procedures are not applicable, and it is necessary to go to much more refined studies.

Dr. Jacobson: I would like to second Dr. Terris' call for these three kinds of experiments and to point out one very great need: that this kind of nutritional data be obtained on the healthiest women in the country. Most of our data come from clinics, university hospitals, etc. We have very little data on optimally healthy people with optimum pregnancies. These definitely should be included in the design.

Dr. Clifford: A few years ago, I was a member of the exchange mission to the Soviet Union. With us, among others, were Drs. Katherine Bain, Allan Barnes, and Bernard Greenberg. We were very much impressed by the fact that in the USSR, the premature infant rate was only 4.8 percent. Dr. Greenberg's job was to analyze this statistical claim which we found in each of the Republics we visited. He found several reasons for it. First of all, they did not report any live birth over 28 weeks; second, they did not report any live birth over 1,000 grams; and, third, they did not report any live birth that died in the first 24 hours. But, taking all of these factors into consideration, Dr. Greenberg's conclusion was that their rate was probably 5 or 6 percent. Then, we went to the Institute of Nutrition in Moscow where their reason for the low rate was that they supplement all of the women. A great protein shortage exists in the Soviet Union, so they supplement all of the diets. We asked what standards they use. They looked shocked and said, "Why, it came from your hospital—Bertha Burke at the Lying-In Hospital. We read about the 100 grams per day, and we received permission from the Academy of Medical Science to have an experiment. We took 28 women and we fed them 100 grams of protein a day. None of the women died, none of the babies died, and there were no prematures. So, we approved the experiment and the Academy of Medical Science made it mandatory in the entire Soviet Union. Every woman when she registers gets permission to have 100 grams of protein a day. If she can't afford it, her union provides it." Here is a mass experiment. That's all we have to do—get Congress to approve 100 grams of protein a day.

Dr. Pearse: At the present time, to my knowledge, the Children's Bureau is supporting only four research projects which are obstetrically directed: one of them is Dr. Gold's; one is the American College survey of obstetrical care in this country; there is a very small one that our department has in education; and there is one additional one. Indeed, much needs to be done. The bulk of the projects that come into the Children's Bureau's Research Committee are, I would say, not very well conceived. Those from most of the obstetricians, unfortunately, could use in their design some constructive suggestions from someone like Dr. Terris. These studies need to be done. Therefore, we must devote some attention to who is going to do them and to properly design them; then they might well be supported.

Dr. J. D. Thompson: My comment is related to the question concerning anesthesia in obstetrics which Dr. Tompkins directed to Dr. Apgar. I agree with Dr. Apgar that is is most important that anesthesia be given by properly trained personnel, but it is also important to recognize a variety of obstetric complications, the proper and modern management of which requires the immediate availability of anesthesia. I refer, for example, to breech delivery, prolapse of the umbilical cord, intrapartum fetal distress, uterine tetany, shoulder dystocia, and a variety of other problems which, if improperly managed, may result in the delivery of a dead or damaged child. Unfortunately, when anesthesia is needed for the management of such obstetric complications, it is usually needed immediately. That is no time for the first-call anesthetist to be tied up with a hip nailing, and the second-call anesthetist to be at home.

Dr. Charles Flowers did a study of obstetric anesthesia in all hospitals practicing obstetrics in North Carolina. The study was published in 1963. Dr. Flowers, I would like to give a few pertinent points from that study which, I believe, bear emphasis. North Carolina is not necessarily a typical State, but the deficiencies in obstetric anesthesia coverage in the smaller hospitals in North Carolina are probably duplicated in all small hospitals throughout the United States and, certainly, are duplicated in my State of Georgia. The data in this study indicate that formal anesthesia coverage for obstetric patients is seldom or never available in 43 percent of hospitals. Also, there is no anesthesia coverage by physicians in 66 percent of hospitals where deliveries occur. The 20 hospitals utilized only graduate nurses who were on regular hospital duty—the labor floor nurse, the night supervisor, and like personnel—and an additional 9 percent used licensed practical nurses and aides who gave 15 percent of the anesthetics, or approximately 300 anesthetics per year. To me, the data in this study are alarming. Seventy percent of the hospitals had no nurse anesthetist for obstetric anesthesia, and 9 percent of the obstetric anesthesia was delivered by these licensed practical nurses or aides. This is a very critical problem in our nation and one, I feel, that addresses itself to public and private health, medical and hospital groups and organizations.

Dr. Wasserman: Thank you all for your thoughts and deliberations.

SESSION V

Specific Needs to Improve Maternity Care

Session Chairman: MARTIN L. STONE, M.D.

OPENING REMARKS

DR. GOLD: Before turning this Session over to its Chairman, Dr. Martin L. Stone, I will briefly summarize the issues and activities of Sessions III and IV.

Dr. Tompkins commented on the positive course of future financing of maternity and infant care and family planning services at the Federal level.

Dr. Bishop discussed the "Prevention of Premature Labor" with a three-front attack: (1) prophylaxis, concentrating on the improvement of the social, economic, and educational status of the nation, together with management of antepartum and intrapartum complications; (2) the early recognition of high risk patients; and (3) the active and early institution of drug therapy to inhibit premature uterine contractions with isoxsuprine and methanesulfonamide. Dr. Fuchs added to the latter his experiments with intravenous alcohol.

Dr. Benirschke stressed emphasizing the teaching of the pathological-physiological aspects of pregnancy in the medical school curriculum rather than the technical aspects of delivery. He also raised the provocative consideration of mycoplasma T as an etiologic factor in the production of the amniotic sac infection syndrome in premature births.

Dr. Jacobson raised the issue of our responsibility in many areas, such as the working mother, and the development of goals and standards relating to the health of mothers and babies, and that we teach these responsibilities in the medical school curriculum. He also recommended adoption of the WHO concept of maternity care. In addition, Dr. Jacobson suggested that we redefine adequate prenatal care within the context of preventing premature birth and mental retardation; also, that nutritional services and research be expanded, and specific service programs for certain high risk situations be devised and used.

Dr. Kaiser emphasized the need to delineate and differentiate the environmental versus the genetic determinants of premature birth. He pointed out the maternal effect on duration of pregnancy and fetal size.

Dr. Gellis raised the provocative issue of the role of sensory contact of the premature in the prevention of mental retardation. This thesis suggested changes in the care of the low birth weight neonate. Dr. Fomon, however, took issue with this concept.

Dr. Gruenwald reemphasized the need to reclassify and redefine prematurity and low birth weight.

Dr. Krantz spoke on the added parameter of bone age as prognostic of fetal maturity and of respiratory distress syndrome complications. He also alluded to the role that emotions play in the etiology of prematurity, especially in cases of out-of-wedlock pregnancies.

Finally, the hazards of anesthesia were discussed in relation to prevention of prematurity, and there was reiteration for the need of competent, qualified anesthesiology coverage in the delivery suite.

I now turn this Session over to Dr. Stone.

Dr. Stone: We will now turn our attention to "Specific Needs to Improve Maternity Care." The second half of the Session will be devoted to the recommendations of this National Conference relating to the prevention of mental retardation through improved maternity care.

PANEL DISCUSSION

DISCUSSION

by

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The 1962 Report of the President's Panel on Mental Retardation contained the mandate that this country must take steps to reduce the incidence of mental retardation. In 1963, Congress passed legislation and provided financial support making possible the Children's Bureau program to reduce mental retardation through improving maternal and infant care. The hypotheses upon which these programs were based were that through improved maternal care, infant mortality could be reduced; secondly, the incidence of low birth weight, prematurely delivered infants could also be reduced, and, through the achievement of these two objectives, a reduction in the number of children with mental retardation would result.

The Child Health Act of 1967 improved the programs by adding reduction in infant and maternal mortality as objectives, and by including support for family planning in the legislation.

There has never been a public health problem about which we have had such specific statistical information. Vital statistics from the Children's Bureau have identified the counties in the United States with the highest infant mortality, and any city could still further pinpoint the actual census tracts experiencing the highest mortality rates. It is well known that these are the areas that harbor the poor, the indigent, and the near needy

Thus, this campaign has the tremendous advantage of being able to concentrate on the geographical areas of greatest need and, thereby, conserve manpower and resources. This campaign has additional advantages, for even in the areas of high mortality it is not necessary to provide equal care to all pregnancies. A new approach has been provided through being able to identify certain conditions in the past history and current pregnancy that will select patients with a high risk of producing an abnormal offspring. It is thus

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From the Boston Hospital for Woman, Lying-In Division, and the Departments of Obstetrics and Gynecology and Pediatrics, Harvard Medical School. Supported by Grant (NB-02372) and contract (P.H. 43-68-15) from the National Institute of Neurological Diseases and Blindness.

possible, even in a high mortality zone, to further narrow the problem and provide individual and special care and study for the potentially high risk patient.

There is a need to further narrow the meshes in our screening so that the yield of abnormal offspring is increased in any high risk category. Granted that a 10 percent yield may make the variable on which high risk is defined statistically significant, yet it means that 90 with the same variable will be normal with no effort having been expended. The high predictability of erythroblastosis makes its management in a special clinic most practical and successful. Therefore, the operating programs should be searching for combinations of variables that will sharpen the high risk profile and increase the yield of abnormals.

Once a patient has been diagnosed as high risk, we need to know what to do with her in order to alter the anticipated outcome. Too frequently, a high risk patient is referred to a special clinic, but there receives no treatment but that which had or would have been given routinely in the regular clinic. The opportunity exists in the various projects to conduct research in these areas and to produce a method of management that can be proven effective.

Along the same vein, we may recommend that a patient be given interconceptional care, but what specifically is the program for an individual complication, and how can we be sure that what is advised is not folklore? There is need for scientifically testing various interconceptional programs with proper controls.

Every step in the various maternity care programs needs to be evaluated in order to determine which programs are effective and which should be discarded, to the end that a streamlined protocol can be achieved.

We need to have a means of assaying the success or failure of an entire project. The statistical information that would make this possible should be continuously supplied and should be evaluated at least quarterly. The simple data as to the fetal and first week mortality per 1,000 total births and the incidence of live births of 2,500 grams and under should be sufficient.

The Children's Bureau may have already developed a computerized program to accumulate and analyze pertinent data. If not in existence, there should be an unbiased, multidisciplinary advisory committee of experts constantly reviewing results, suggesting changes, additions, or eliminations. From the data, they should be able to suggest pilot studies to test new and imaginative approaches.

As has been stated, in the present plan of attack it has been possible to identify the geographical pockets of high mortality and, further, to screen out the pregnant women with a high risk of having abnormal infants. It is also possible to further identify the small group of pregnancies that produce nearly 90 percent of the first week mortality.

The table on page 197 is the result of a study of 14,612 total births at the Boston Hospital for Women, Lying-in Division:

It is thus seen that the greatest obstacle to registering a real reduction in the first week mortality (and accounting for 6 per 1,000 of the total infant mortality) is the live born infants weighing 1,000 grams and under. Only 7 of

Grams Birth Weight	*Number per 1000 Total Births Live Born*	*1st Week Mortality per 1000 T.B.*	*Percent of 1st week Live Born Deaths*
< 1000	7	6.2	42
1001–2500	81	6.6	44
2501 >	900 (12 Stillborn)	2.2	14
Total	1000	15.0	100

these babies are hidden away in every 1,000 deliveries, yet they contribute 42 percent of the first week mortality. This problem would be purely academic if all of these infants died. However, the bitter fact is that 10 percent of them survive, with their accompanying huge incidence of mental retardation, cerebral palsy, and other neurologic disorders. Each year with 3½ million births, this would mean 2,500 high risk survivors who had weighed 1,000 grams or less at birth.

Every program must be aware of this dangerous group and plan accordingly. In the first place, these births occur between the 20th and 27th completed week of pregnancy. Therefore, preventive measures must be instituted prior to and during this period. In this light, the traditional frequent prenatal visits of the last 6 weeks of gestation seem ridiculous since, by then, 90 percent of the mortality is a matter of history.

My studies of the live born infants of 1,000 grams and under suggest that real possibilities exist for improving the outlook for these babies.

To my surprise, the complications associated with the stillbirths were found to be quite different from those associated with the live born deaths:

Major Complication	*Percent of 70 Single Stillbirths*	*Percent of 89 Single Live Born Deaths*
Bleeding	21.4	46.1
Infection	20.0	24.7
Incompetent cervix	8.6	23.6
Erythroblastosis	24.3	2.2
Placental insufficiency	15.7	1.1
Congenital malformation	7.1	1.1
Unknown and miscellaneous	2.9	1.2

Erythroblastosis, placental insufficiency, and congenital malformation were found to be associated predominantly with the stillbirths. Infection, bleeding, and the incompetent cervix were the well-recognized obstetric complications found associated with nearly all the 1,000 gram and under live born deaths.

Infection was considered the primary factor in one-quarter of the cases, but, in another one-quarter, it was an important secondary finding. The diagnosis was made clinically from fever, chills, high white blood count, increased polymorphonuclear cells, and vaginal discharge and culture. Microscopic examination of the placenta was done in 97 percent of the cases and was of the utmost value in determining the presence and extent of the intrauterine infection. Autopsy examinations were performed in 90 percent of the group. Some of the mothers were unwed, with positive or suspected instrumentation. Many had prolonged rupture of the membranes. An interesting finding was that a number of the extensive infections had followed long intervals of blood staining. The presence of infection in 50 percent of the live born deaths with a birth weight under 1,000 grams suggests the real possibility of prevention, early diagnosis, and treatment.

Early bleeding was a real problem in this group; nearly half of the cases had it alone or combined with infection and/or instrumentation. Abruptio placenta was present in 90 percent of the bleeding cases. A circumvallate placenta was noted in 39 percent and massive decidual necrosis recorded in 65 percent. Investigations on the management of early bleeding should be a fruitful contribution from the current programs. Perhaps a folic acid deficiency can be demonstrated as a possible cause for this early bleeding. Clearly, there is a great need for research on the etiology, prevention, and treatment of early bleeding.

Definite or probable incompetent cervix was associated with one-quarter of the live born infants below 1,000 grams. Diagnosis on the initial case requires vaginal examination by speculum early enough in gestation to permit treatment. After having been diagnosed, subsequent pregnancies should benefit from interconceptional care, early registration, and frequent specific examinations.

Unfortunately, in many instances, it is the patient herself who defeats the possibilities for prevention, for of the 174 women in our study, 25 percent were unregistered admissions, and 5 percent were emergency admissions referred by outside physicians.

The greatest need of all is to somehow transform the second-rate citizens who exist in the high mortality areas into honored, respected, self-confident, first-class members of our society. The need encompasses many of the ills in our society of which infant mortality is but a part. It is quite probable that no real progress in lowering mortality will be made until this problem is solved.

Obviously, that is far greater than a medical problem, although the profession will undoubtedly be blamed for not succeeding along medical lines in lowering the mortality found in these areas. In this connection, there is a need to include in a conference such as this, representatives from these problem areas. They need not be physicians; they might be psychologists, educators, ministers, social workers, or anyone who has lived with the problem.

The remarks of Dr. Sprague Gardiner[1] are most pertinent, since most of the need for improving maternity care is in the low socioeconomic class—the so-called "poverty group" of the urban community. The American middle class exhibits a concern for, and active and sustained participation in, long-range planning for the future. It is the group with the lowest neonatal mortality; it is the group that makes up the physician's private practice and with which he easily identifies himself, for his background is similar to theirs.

In sharp contrast, the poverty group is more than just the absence of income; it is an entirely different way of life. The people in the poverty group perceive, judge, value, interpret, and understand quite differently. They are fatalistic, have no confidence in the future, and live from day to day, crisis to crisis. Medical care is sought only when the discomfort becomes severe enough to constitute a crisis.

Dr. Gardiner has clearly outlined a need if maternal care is to be improved in these underprivileged areas. We must understand the poverty group's culture and problems. We must reorient our obstetric care more in terms of the mother's needs and capabilities. We must make each antepartum visit a meaningful experience for the patient, consistent with the relative importance of her various life crises. We must elicit and understand her current personal, interpersonal, social and economic problems and needs. We must remember that antepartum care is only one of her needs and, in her mind, all too often of minor importance. We must be familiar with the resources which might be mobilized to offer a temporary solution to her problems and to help meet some of her immediate needs.

It has been stressed that prenatal care should begin with the birth of a girl and continue to maturity. This would include physical and mental health, education, including sex education, premarital genetic counseling and family planning, including contraceptive information.

Dr. Gardiner points out that the great majority of pregnancies in the low socioeconomic class are unwanted, and the emotional reactions of anger, guilt, and depression, particularly in the unwed mothers, result in varying degrees of social withdrawal and isolation, or passive noncooperation with those who want to help them.

The obstetrician now says, you give us better mothers and we will give you better babies. How one can provide better candidates for motherhood from girls raised in an underprivileged environment will take the wisdom of a Solomon.

There is a need to reexamine and redesign the whole system of prenatal care to retain that which can be proven effective and to test new approaches. In this connection, as has been stated, the Children's Bureau should provide feedback material from the programs now supported to assist in designing or revising programs. No less an authority on biostatistics than Dr. J. Yerushalmy has stated that it is unfortunate that after decades of experience with prenatal care, we are not able to say with conviction whether the tremendous effort exerted in the provision of prenatal care has been worthwhile. He gives the usual prenatal care program little chance of success, for he believes that the high risk case must be identified before pregnancy since, by the time the pregnancy has been identified as high risk, much of the damage has already been done. He makes the practical suggestion that the high risk pregnancy be identified at the end of the preceding pregnancy and a program of action initiated at once.

If there is value in prenatal care, it is axiomatic that it must be initiated early in the first trimester. Our inability to achieve early registration in the areas of high mortality is well known. One cannot escape the feeling that the doubts on the part of the medical profession as to the efficacy of the present system of prenatal care are at the root of the problem. Convinced of the value of polio immunization, medicine, public health, government, and the news and advertising media all actively participated in successfully selling the program. The same could be true for prenatal care if we could offer convincing proof that it is of real value.

There is good reason to believe that a real reduction in infant mortality with its dividend of reduction in mental retardation, will be the result of research on the fetus in utero. Already, the fetus has benefited from studies on the amniotic fluid, from intrauterine transfusions, and from the protection of the mother from sensitization to fetal blood cells. A method of determining the status of placental function through measuring human placental lactogen (HPL) gives great promise. There may be a deficiency state associated with early placental bleeding. The science of fetology should be given every encouragement and support.

I will conclude with the needs expressed by the National Advisory Commission on Health Manpower:[2]

- The need to conserve health manpower through an integrated system in which needs and efforts are closely related.
- The need to have peer review groups keep an eye on the various professional groups that make up the system and encourage improvement in quality, greater efficiency and reduction in costs.
- The need to change Medicare and Medicaid payments to organizations providing comprehensive care from a cost reimbursement basis to one which will permit the organization to share in the savings they achieve by effective control.
- Hospitals, institutions or medical schools should determine the volume of comprehensive maternal care they can manage efficiently; determine the geographical area in their region that will provide this intake; estimate their total cost to provide high quality service; and apply for approval and support on a contract, rather than on a grant basis.

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DISCUSSION

by

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Shortly after the turn of the century, appalled by the incredibly high puerperal and infant mortality rates, leading obstetricians throughout the country desperately sought reasons for this tragic loss in terms of both maternal and infant mortality. The lack of quality maternity care and supervision during the prenatal period was soon recognized as one of the most important factors in determining pregnancy outcome. Soon, prenatal clinics, pioneered by men such as Joseph B. De Lee in Chicago, were established and rapidly made an impact on maternal and fetal loss, puerperal mortality being reduced from 60.8 per 10,000 births in 1915 to 3.4 in 1964, and infant mortality dropping from 99.1 per 1,000 births to 24.8. Thus, the importance of maternity care and frequent observation of the gravid mother during the prenatal period was clearly established.

However, despite the successful and continued reduction in puerperal mortality, infant and perinatal mortality rates have been little affected during the past 15 years. A review of the *Vital Statistics* for the City of New York reveals that the infant death rate was 24.5 per 1,000 live births in 1949 and 25.7 in 1965, whereas the perinatal mortality rate was 31.3 in 1949 and 29.9 in 1965.[1] A new assessment of maternity care is obviously needed. The questions to be answered, first, are: (1) Is the concept of prenatal care still valid in attempting to further reduce perinatal mortality, or have we reached an irreducible minimum in perinatal reduction utilizing the traditional principles of prenatal care? (2) Is prenatal care available to those who need it most and, if so, are they utilizing available facilities? (3) Are there other concepts or programs which must be developed and instituted to further reduce perinatal mortality?

A careful analysis of the *Vital Statistics*, for the City of New York for 1965, reveals outstanding factors which undoubtedly play a prominent role in perinatal mortality.

1. *Late or No Prenatal Care.* 23.1 percent of the total population of New York City had little or no prenatal care. However, in those districts where the residents were predominantly indigent or of the lower socioeco-

nomic group, this lack of prenatal care increased to 35 to 45 percent. As the rate of poor or no prenatal care increases, the infant mortality rate and prematurity rate increase in direct ratio. Thus, in Bedford-Stuyvesant, where 45.2 percent of the residents received late or no prenatal care, the infant mortality rate was 41.9 per 1,000 compared to 25.7 per thousand for the entire city, and the prematurity rate was 14.8 percent versus 10.1 percent citywide. In Flushing, where only 7.2 percent of the residents received late or no prenatal care, the infant mortality rate was 16.1 per thousand and the prematurity rate was 7.2 percent (both being among the lowest in the city and well below the citywide average). Clearly, we must still be vitally concerned with providing prenatal care to *all* pregnant women—and providing it early and frequently.

2. *Ethnic Background.* The second outstanding factor which is even more striking, and undoubtedly has a close interrelationship with lack of prenatal care, is the disturbingly higher rates of infant mortality and prematurity in the nonwhite versus the white groups. Bedford-Stuyvesant and Central Harlem, communities which had 82.2 and 94.4 percent nonwhite births, also had the highest infant mortalities, 41.9 and 37.2 per thousand, and the highest prematurity rates, 14.8 and 16.9 percent respectively.[1] These figures indicate that the infant death and prematurity rates are two times greater in the nonwhite than in the white group. These are significant differences and reflect the socioeconomic plight of the indigent members of our great urban communities. A recent report from the Children's Bureau (*Infant and Perinatal Mortality Rates by Age and Color:* United States, Each State and County, 1956–1960, 1961–1965) reveals that the infant death rate was greatest in 56 counties of the United States which contained the most densely populated areas of the country.

Any attempt to improve maternity care must address itself principally to these broad areas of concern. Therefore, educational programs must be developed on a Federal as well as community level to acquaint the lower socioeconomic groups with the need and value of prenatal care.

There are many deterrents to prenatal care, as pointed out by Monahan and Spencer.[2] Some of these are overcrowded clinic facilities, loss of identity of the patient in large facilities, transportation difficulties or expense involved in travel to clinics, the problem of the working mother or the unmarried minor, cultural differences, poor motivation, fear of doctors or authority, and a host of other problems. These problems must be overcome if a larger number of our indigent population are to receive adequate prenatal care.

Present programs are attempting to find remedies. The satellite clinic plan under the Maternity and Infant Care program is an effective way perhaps of bringing prenatal care to those who may not seek it, either because of distance or other reasons. These programs should be implemented in areas of concentrations of low income families.

As to the quality of prenatal care, the reduction of perinatal mortality has reached an apparent irreducible minimum, probably because maternity care in most prenatal clinics has consisted of mere patient registration and the performance of rather limited general screening procedures and perfunctory physical examinations, usually in the last trimester of pregnancy and directed to the detection only of gross, evident abnormalities.

As a pediatrician, involved intimately and deeply for many years with problems of mental retardation, I am concerned more with the quality of the surviving end product of pregnancy than with perinatal mortality, distressing as this may be. The same obstetric factors which produce mortality also frequently result in irreversible morbidity, leading to mental retardation, cerebral palsy, and other neurological deficits. These disorders of infancy and childhood rank high among the nation's most serious health problems.

Our experience has demonstrated to us that prematurity and low birth weight infants constitute the major basis for the development of mental retardation. Contrary to long held beliefs, mental retardation is only infrequently due to hereditary or genetic deficits. Recognition of the fact that prematurity and low birth weight are related to the problems of the lower socioeconomic status and nonwhite groups should serve as the basis for improved programs of maternity care. Our present Maternity and Infant Care programs are now dedicated to providing service to these groups by identifying the high risk patient who, by demographic standards such as teenage primiparity, grand multiparity, etc., or by medical standards such as problems of nutrition, diabetes, cardiac disease, etc., require more intensive care and followup. These programs are not to be considered as demonstration programs, but should be set up as service programs, and they should be greatly increased in number. The expansion of the objective of these programs should be beyond the concept of maternity care alone—to the presentation of a viable product which can be immediately identified as being healthy or "at risk," with immediate efforts to be made to initiate care to prevent mental retardation on identification of this "risk."

To this end, it is recommended that:

- *The pediatrician be introduced early to the program of maternity care,* perhaps even in the preconceptional or interconceptional period. Certainly he should play a consultative role during the prenatal course, particularly when the use of drugs may be contemplated for maternity treatment. We now recognize the development of hyperbilirubinemia as a result of the use of drugs such as gantrisin, aplastic anemia of the new born resulting from the indiscriminate use of thiazides or antibiotics, as well as teratogenic problems resulting from medications during the early weeks of pregnancy. The pediatrician should be concerned with fetal monitoring in utero for conditions such as Rh isoimmunization, diabetes, chronic hypertensive toxemia, etc. He not only has the right to know what he must deal with after birth, but what may actually prove to be helpful during pregnancy.
- *Present programs utilize the services of a geneticist.* Every mother who has a genetic stigma or has delivered a defective child should have complete genetic screening, involving chromosomal studies, as part of preconceptional preparation for childbirth (or for the avoidance of a subsequent pregnancy). Genetic counseling programs, therefore, are recommended as integral parts of programs for maternity care.

- *Fetal monitoring be developed more fully* and become a standard scientific tool of all prenatal programs. The parameters for fetal monitoring now in existence are of considerable value. These consist of: (a) careful examination and measurement of physical growth; (b) cardiological monitoring, i.e., fetal heart tones and EKG; (c) biological monitoring, i.e., estriol levels, blood chemical determinations, CO_2 (via scalp sampling), etc.; (d) amniocentesis which is now quite precise for Rh problems and is developing an understanding of fetal reaction to conditions such as diabetes, toxemia, etc. By utilizing these techniques, we may be better able to identify those babies who are "at risk" in utero and thus increase the probability of survival.
- *All available testing procedures be employed to detect inborn errors of metabolism*, such as PKU, identifying these problems early and continuing observation after birth.
- *A concentration of efforts be made to protect the premature baby after birth* and to prevent neurological sequellae associated with anoxia. Federal and State subsidy of special care programs for premature babies and subsidy of premature centers are a most urgent need.[3]

These are the specific needs which must be met to improve maternity care and reduce perinatal mortality, prematurity, and mental retardation. The problem must not be oversimplified, for it is, indeed, broad and complex. Assuredly, many aspects of the problem are nonmedical and may only be resolved by sweeping changes in the socioeconomic, educational, and ethnic conditions of our society.

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DISCUSSION

by

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The need for improving maternity care in the United States is well expressed by data that have become available over the past few years which show the marked disparity that exists in the outcome of pregnancy among women in different social classes. In 1966, the proportion of white infants weighing 2,500 grams or less was 7.2 percent, and the comparable figure for nonwhite infants was 13.9 percent. There is a difference of approximately 100 percent between the highest and the lowest State infant mortality rates and between the white and nonwhite rates. Marked racial differences exist also in the age specific birth rates; e.g., 10–14 years, a rate of 0.3 compared with 4.0; for 40–44 years, a rate of 10.8 as compared with 18.4. These data undoubtedly relate to differences in outcome of pregnancy.

That pregnancy and delivery are predominantly normal in their course and favorable in outcome is indicative of the successes achieved by modern medicine, and comparisons with the results of a generation ago are hardly necessary. The less favorable course and outcome of pregnancy among the lower income groups represent, for the most part, the inadequate response of our medical institutions, and society more generally, to the unprecedented social changes which have taken place in the past 20 years in the large cities and the most rural areas. During this period, there has been a massive movement of the population from rural to urban areas and from the cities to the suburbs, leading to the present urbanization of the Negro population, three-fourths of whom are now living in cities.

One result of the great changes in the social and economic characteristics of the urban population has been the overcrowding of existing clinics and the movement of private practitioners to the suburbs. This, in turn, has led to the situation where a large proportion of women in large cities have been receiving poor maternity care. In 1962, the President's Panel on Mental Retardation pointed out that thousands of women, especially in the major cities, were giving birth prematurely from 2 to 2½ times the expected rate; that low birth weight babies were likely to have brain damage; that these women had excessive rates of complications of pregnancy; and that one-fourth to one-half of women of low income in our large cities delivered having had late or no prenatal care. The women for whom pregnancy was accompanied by complications much in excess of the expected were receiving poor care in crowded understaffed hospitals.

Further evidence of the deficiencies of our systems for providing medical care for maternity patients was borne out by a study in California of the barriers to prenatal care. These included:

- Relative inaccessibility of medical centers and difficulties due to expense of transportation.
- Restrictive eligibility requirements which bear little relationship to the rising costs of medical care.
- Mothers frequently work and are the heads of households. To attend a clinic entails loss of a day's pay.
- The clinics are too often crowded, impersonal, and sometimes have unsympathetic staff. Clinic policies often have little relationship to the needs of the population they serve.

In 1964, a Maternity and Infant Care program was started in an effort to respond to these problems and to make changes in the system of providing maternity care for women of low income families. Fifty-two projects are now in operation, and last year 103,000 women were admitted to the programs, 86,000 were delivered, and 58,000 started family planning. In the administration of these programs, our objectives include the reduction of maternal and infant mortality and morbidity, and taking steps which will assist communities in so organizing their services as to increase the accessibility of care, improve the quality of care, and make use of the best available resources.

These programs and the related Comprehensive Health Projects for Children and Youth, and the Office of Economic Opportunity Neighborhood Health Centers, are making it possible for community health organizations to develop new and imaginative methods of reaching out to the people in slum areas, decentralizing services into neighborhoods, reducing crowding in tax-supported hospitals by paying for care in voluntary hospitals, and establishing well-organized systems of providing comprehensive health programs of casefinding, prevention, health supervision, and treatment. Such programs are being carried out in areas where there are few physicians in private practice, and where existing resources are grossly overcrowded. In these areas, they are creating new resources and changing existing methods of delivering health services in order to be responsive to the needs of the people.

It is these programs that have opened the door for the first time to family planning services for thousands of low income families. Because the period of pregnancy is too brief a time in which to detect and correct all the factors adversely affecting the outcome of pregnancy, continuing health supervision for mothers who have had complications of pregnancy is essential. This should make it possible to improve the health of mothers for a subsequent pregnancy and to begin prenatal care early. It should also make possible a longer interval between pregnancies. Through a few of the M & I programs, women are beginning to receive such continuing health supervision following delivery for a year or more. The adoption of this concept of interconceptional care has been strongly urged by the Children's Bureau Maternity and Newborn Advisory Committee, as well as by the authors of several papers given at the American Medical Association National Conference on Infant Mortality in 1966, and published in the Proceedings of that Conference.

One of the most significant contributions of the M & I programs is that they are making it possible for an increasing number of women of low income in large cities to obtain family planning services. Through the Maternity and Infant Care projects and the more rural Maternal and Child Health programs, 300,000 women began family planning services in 1967, chiefly at the postpartum visit. Thus, about 40 percent of the women of the low income group who had babies in 1967 initiated family planning services. In view of the excessive incidence of factors complicating pregnancy in this group, this has a significant bearing on the reduction of infant mortality.

Among 5,939 completed pregnancies for which reports were received between December 1966 and June 1967, the proportion of low birth weight babies was 14.6 percent. Of the white babies, 9 percent were premature; of the nonwhite, 15.3 percent. The highest prematurity rates occurred among nonwhite girls less than 18 years old and nonwhite women more than 35 years.

That low birth weight among nonwhite babies in this program is a serious disadvantage for them is indicated by the Apgar score. Scores of less than 4 occurred among 15 percent of the premature nonwhite infants, which is seven times the rate of such poor scores among nonwhite babies over 2,500 grams. The contention that "premature" nonwhite babies, although small, are not physiologically hindered to the same extent as "premature" white babies is not supported by these data.

In view of the fact that out-of-wedlock pregnancies among very young girls are increasing, emphasis is being placed on comprehensive programs to reduce subsequent pregnancies among these girls. In the St. Louis M & I program, it is reported that during 1966, 40 percent of the patients were 19 years or less; 68 percent of them were not married, and 25 percent had had a second or third illegitimate pregnancy by age 17.

It is estimated that if current national trends continue, during 1970 approximately 70,000 girls under 18 years of age will have a child born out of wedlock.

If these girls follow current patterns, they will give birth to 238,000 children in a 5-year period. These figures are based on the New Haven Study by Sarrel. (See Sarrel, Philip: The university hospital and the teenage unwed mother. *Amer J Pub Hlth* 57:1308 (August) 1967.) In a 5-year period, 100 girls under 17 with one out-of-wedlock pregnancy had 240 more babies and 9 abortions. Only 5 girls did not become pregnant again in this period, and of those who married, only 9 of the total of 100 were still living with their husbands. Sixty of the 100 girls and their children are now being supported by welfare.

A program focused on young unmarried mothers must be widely extended if we are to interrupt the cycle of failure to continue education, dependence on welfare, absence of normal family life, and continued reproduction of illegitimate offspring.

To reduce recidivism, these girls require a comprehensive program including health, education, and social services. These services have little effect upon recidivism if they are fragmented; all studies support this conclusion.

There are now in existence 36 new projects relating to school-age pregnant girls. Most of them followed from the experience of the Children's Bureau-supported demonstration project in the District of Columbia which provided comprehensive services to approximately 500 pregnant school-age girls. (See Children's Bureau Research Report No. 2, *The Webster School: A District of Columbia Program for Pregnant Girls.* U.S. Government Printing Office, 1968.) The Children's Bureau budget request for 1969 includes $3 million for such projects as these, in addition to the services provided through the M & I projects.

The Child Health Act of 1967 (included in the Social Security Amendments) extends the authorization for the M & I projects to June 30, 1972. It specifically states that one purpose of this program is to reduce infant mortality, thereby making it clear that the full range of care may be made available to mothers and children of groups where such mortality is highest. It authorizes, for the first time, project grants to public and voluntary agencies for family planning services. Of the amount appropriated under Title V of the Social Security Act, not less than 6 percent shall be available for family planning activities. The 1969 budget request includes $24 million for family planning, or 10 percent of the budget. It provides for project grants for infant care, particularly for the support of intensive care units for the newborn. The Federal funds may meet up to 75 percent of the costs of these projects.

Under the welfare provisions of Title IV of the Social Security Act, State welfare departments will be required to offer family planning services to certain women who are recipients of AFDC. Welfare departments will be dependent to a considerable extent upon the expansion of medical resources to provide the family planning services.

In his State of the Union Message on January 17, 1968, President Johnson stated, "I shall therefore propose to the Congress a Child Health Program to provide over the next five years for families unable to afford it, access to health services from prenatal care of the mother through the child's first year."

References to this proposal were made in three subsequent Messages, with greater elaboration in his Health Message of March 4, 1968. In these Messages, there were repeated references to infant mortality. It was pointed out in the Health Message that "The infant mortality rate among poor families was nearly double the National average." The Message further states that infant mortality has started to decline significantly and that large reductions are taking place in cities with maternity and child health programs.

The current marked interest in the infant mortality rate is derived from its usefulness as an index of social conditions and from the fact that, until 1966, progress in reducing the rate in the United States was slow. Of particular concern is the disparity that exists in the rates among different economic groups in the population.

During the 10-year period 1956–1965, the infant mortality rate decreased by only 5 percent. In 1966, the rate of 23.7 was 4 percent less than in 1965, and the provisional 1967 rate of 22.1 is over 6 percent less than the previous year. Thus, in the past 2 years, the infant mortality rate has declined twice as much as in the entire previous decade. Whereas only 3 of the 21 largest cities had reductions in infant mortality rates between 1961 and 1965, we are now seeing much larger reductions in these cities than for the nation as a whole.

In the District of Columbia, which has a higher infant mortality rate than any other city in the nation, the rate decreased from 35 in 1966 to 33 in 1967. The Negro rate decreased even more, from 38 to 33 or by 13 percent. The M & I program made it possible to increase admissions to the city's prenatal clinics from 5,000 to 9,000 in 3 years and, last year, a 37 percent increase in admissions to family planning to 6,000 women.

In Houston, the infant death rate declined from 26.4 in 1966 to 22.1 in 1967, a 16 percent reduction. The maternal mortality rate decreased from 6.15 to 2.67 per 10,000 birth. The M & I project in this city is administered by the health department, in conjunction with Baylor University School of Medicine and the Houston Planned Parenthood Association.

Chicago, with a large M & I program admitting 19,000 maternity patients annually, had a 9.2 percent reduction in infant mortality in 1967, from 32.5 in 1966 to 29.5. The rate among Negro infants decreased by 16.7 percent. Similarly, Baltimore experienced a 4.3 percent reduction for all infants, with a 13.3 percent reduction for Negro infants. The 1967 rate of 26.8 is the lowest ever recorded in Baltimore.

It is the neonatal rates that are principally affected by these significant changes. These cities have large Maternity and Infant Care and family planning programs. While the reasons for this dramatic change in infant mortality have not been established in a cause and effect relationship, the only new contributory factors which have been identified are the rapid increase in family planning among the poor and comprehensive Maternity and Infant Care programs focused on the most vulnerable population.

To accelerate progress in the reduction of infant mortality during the next 5 years necessitates increased program development in maternal and child health and family planning, especially in the counties with excess rates. Nearly one-third of the infant deaths in excess of the rate of 17.8 per 1,000 live births (which was achieved by 10 percent of the counties) occurred in only 42 of the 3,000 United States counties. Another 30 percent of the excess infant deaths occurred in less than 10 percent of the counties. These are the areas in which future efforts to accelerate the reduction in infant mortality must be concentrated.

If it were possible to eliminate entirely in the next 5 years the 30,000 annual excess deaths in infancy, the United States rate would be 17.8 per 1,000 or less in 1972. Is this a reasonable expectation? It would require an annual decrease of 2.48 percent. A year ago, such a prospect would have been most doubtful, since the annual decrease in the decade 1956–1965 was only 0.8 percent. However, if reductions of 4 to 6 percent in the 1966 and 1967 provisional rates are borne out by final figures, the goal of 17.8 by 1972 does not appear to be unrealistic. But a program to accomplish this would require financing on a larger scale than is currently provided for by the Child Health Act of 1967.

To achieve the objectives of further reducing infant mortality and of providing good maternity care for pregnant women and for infants, the President in his Health Message proposed the Child Health Act of 1968. He stated—"Our goal is to assure every needy American family:

- Adequate prenatal and postnatal care for the mother.
- A safe delivery by trained health professionals.
- Competent examination of the child at birth, and expert treatment when needed.
- The best of modern medical care for the infant during his first year to prevent disease, cure illness, and correct handicaps.
- An opportunity, on a voluntary basis, to plan the number and spacing of children."

The program which is being drafted will build on the experience gained in the Maternity and Infant Care projects to provide maternity and infant care by the fifth year to between 500,000 and 750,000 women of low income and their infants. State plans would be so designed as to show progressive extension of these services until they are available to women and infants of low income families in all parts of each State. Such a program can be expected to reduce significantly the disparities in the amount and quality of care, as well as in the infant mortality rates between the different income classes in our society.

DISCUSSION
by

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When we speak of specific needs in improving maternity care, I believe that two major recognitions are necessary. The first of these is the recognition by individuals at all levels of responsibility of the importance of improving maternity care. The second is recognition by those close to the scene that neither the medical care nor the personnel patterns of the present will suffice to improve maternity care in the future.

If all deaths from heart disease, cancer, and stroke had been eliminated in 1967, only 14 million life years would have been added to the population of the United States, whereas 17 million life years would have been added if all perinatal mortality had been eliminated in that same year. We must secure recognition that the problem of improving maternity care is a major health problem in this country—one that merits as much attention as poliomyelitis, cystic fibrosis, or stroke. As the second example, if we attempt to improve maternal health care simply by adding more trained specialists to the suburban shopping centers around our major cities, or by providing one more prenatal visit to every pregnant woman in the country (only to check her weight and blood pressure), it is unlikely that our perinatal casualties or perinatal morbidity will be reduced.

This Conference has helped to bring into focus the major immediate problems that face us in maternal health care today: prematurity and fetal distress in utero, both acute and chronic. What can be done to attack these problems? All of us must speak for the unborn.

At the Federal level, the Association of Medical School Pediatric Department Chairmen and the Association of Professors of Gynecology and Obstetrics, among other groups, have made progress in increasing recognition of the needs by responsible individuals in Government. We need to continue to support those in the Department of Health, Education, and Welfare who, for many years, have been concerned about our children.

At the State level, comprehensive health planning is becoming a reality. As illustrated below—an initial outline of comprehensive health planning in our State—health begins with the individual and is related both to his per-

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sonal health and to environmental circumstances. In the category of maternal and child health, and family planning, we should make the importance of the problems and our proposed solutions to them widely known at the State and regional level.

INDIVIDUAL HEALTH

PERSONAL HEALTH	ENVIRONMENTAL HEALTH
Acute Illness	Air
Chronic Illness Adult	Water
Mental Illness Adult	Food
Maternal & Child Health Family Planning	Waste
	Housing
Infectious—Parasitic Disease	Radiation
Trauma	

In the health services field, empiricism is rapidly disappearing, as it disappeared long ago in the laboratory. This empiricism in the delivery of services is being replaced by systems analysis and its approach of problem definition, goal development, activity alternates, and cost effectiveness. Without in any way ignoring these methods, some activities would seem essential.

In recognizing the second major need then, we must examine existing personnel and present care patterns. It is clear that more trained obstetric personnel are necessary in this country. It is less clear why every obstetric resident needs to be trained as a radical cancer surgeon. A 3-year residency with emphasis on obstetrics and medical gynecology, with the addition of a year of straight internship if our medical school curricula are suitably revised, ought to produce a well-trained maternal health specialist. Next, it is imperative that these obstetricians be located in the rural areas and inner cities where they are most needed. This can be accomplished in three ways:

1. By emphasizing group practice so that the physician is well supported by other medical disciplines in his own locality.
2. By developing trained obstetric assistants and other members of the health team so that the physician is well supported in his specialty.
3. By establishing excellent communication with both first- and second-line referral medical centers, including provisions for patient transportation and two-way television so that the individual physican does not feel isolated from the mainstream of a rapidly progressing medical science.

Changes in patterns of care are also necessary, and there seem to be four areas of consideration. First, we should do a better job of emphasizing to the consumer the importance of premarital and preconceptional care. The time gap between the last visit to the pediatrician when a girl enters high school, and her first prenatal visit must be eliminated. While we are not now talking about specific research needs, the problem of nutrition of the mother and fetus in its broadest sense appears to be vital to both the challenges of prematurity and those of acute and chronic fetal distress. Prenatal care may not be able to provide the answer, but preconceptional nutrition is probably crucial. Family planning should be available to all who desire it in the premarital and interconceptional periods. Today, considerable care gaps exist in our rural areas, and even in our large cities where most of the recent emphasis has been placed.

Secondly, we have already alluded to the health team approach. The Maternity and Infant Care projects of the Children's Bureau have demonstrated the benefits available to the pregnant woman when she is seen not just by a physician, but also by a nutritionist, a visiting public health nurse, a social worker when necessary, and a psychologist to provide routine screening for emotional high risk factors in pregnancy. These benefits have been extended through the M & I programs to about 2 percent of the pregnant women in this country, generally those considered to be medically indigent. Probably, these are the people who have the greatest need for such services, but the remainder of our population should not be denied these benefits if they offer something substantial—and evaluation suggests that they do.

The third area of need is that of more sophisticated care facilities. With the declining number of births over the past several years, hospitals have been reluctant to upgrade obstetric facilities, and those hospitals planning new facilities have generally seemed to do so without much imagination. While surgeons organize intensive care and recovery areas, and internists develop coronary care units with the latest in monitoring devices, only a few pediatric intensive care units have been developed, and almost nothing has been done in the field of obstetrics.

The survey of the Hospital Planning Council of Southern New York indicated that efficient staffing and operation of the labor, delivery, and newborn nursery units would require a minimum of 2,200 deliveries per year. How many times have we seen examples of hospitals independently planning new facilities to accommodate 1,200 or 1,500 deliveries per year, while a few short blocks away another hospital was developing an identical unit? We have a need then, not only to combine facilities within a community (such as accomplished by the Rochester Community Pediatric Program), but also to develop centrally located obstetric and pediatric intensive care units, in communication with outlying centers. What is envisioned and in practice for care of the heart patient should certainly be considered for our unborn citizens.

The final, but major, problem is financing the type of health care that we are defining. Obstetric hospital care in our area now costs close to $100 per day. A routine delivery with a 5-day hospital stay will cost the average couple $800, including hospital care, physician's fees, laboratory studies, and medication throughout the pregnancy. However, hospitalization and professional insurance to cover these expenses is somewhat difficult to obtain by young couples who are usually at a low point in their earning power. Insurance coverage is either restricted in terms of dollars per day or some flat rate for total hospitalization. When professional fees are included, they may pay part of the cost toward delivery but seldom for pre- or post partum care. Many have pondered over this problem, and indeed Medicare programs were developed as a partial solution to a similar problem for our citizens over 65. The concern in younger age groups has often been that of the long-term illness or disability. But we will have to face the problem of providing the high quality obstetric care that has been described, or simple economics will force the pregnant woman to seek care of inferior quality and hospital facilities that offer minimum service.

In summary, I would plead that we recognize two major needs: universal awareness of the maternal health problem, and realization that our personnel and care patterns of past and present will not serve for the future. Many of you have contributions to make at the Federal level, and almost all of us will participate in one way or another in comprehensive health planning in our areas and in our States. We need imaginative plans to develop more maternal health personnel at all levels and to disseminate them more widely in our geographic areas. In our patterns of care, we need to emphasize preconceptional care, the health team approach, more sophisticated facilities, and better means of financing these changes. It would seem that regional centers for maternal health care would be an obvious first step.

DISCUSSION
by

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President Johnson, in his 1968 State of the Union message, highlighted the need to improve maternity and infant care and to reduce infant mortality. With the exception of reference to the problems of providing care for the aging, the indigent, and the medically indigent of our country (Titles 18 and 19 of the Social Security Act), the President selected as top priority in health needs of our country essentially the same topic as that on which this Conference is focused.

It is clear that tremendous progress in the maternity and infant care field was made in our country in the first half of the 20th century. In the 1950's, we reached a plateau in progress, and since the 1950's we have lost ground in comparison with other countries. It was not until 1963, with the legislation setting up Maternity and Infant Care programs and in 1965 setting up programs providing comprehensive care for children and youth, that we began to take newer steps.

At this time, I wish to make it clear that I regard the M & I projects and the C & Y projects as significant early steps forward. They represent our initial efforts to provide comprehensive care for high risk, high priority groups. These efforts are to be congratulated.

However, I do not want to emphasize what we have done. Rather, I want to stress "What more can we do? And how can we do better those things we have already begun?" Thus, if what I say seems to be an appraisal or a critique, it is with the purpose of trying to move us further along.

The Extent of Coverage by Comprehensive Patient Care Services

Programs providing comprehensive care for mothers and children are presently reaching only a small proportion of the total high risk population. There are two future approaches possible: (1) to extend M & I and C & Y programs as rapidly as possible to all high risk mothers and children requiring comprehensive team care; and (2) to assist existing traditional community services (e.g., maternity and prenatal clinic services, well child conferences, school health services, services for adolescents, hospital outpatient departments, etc.) to be remolded to provide comprehensive care. It would appear that both of these approaches must be used. I suggest that one of the recommendations which should stem from this Conference is that Federal appropriations be increased as quickly as possible to facilitate this.

An example of upgrading an existing community service to provide comprehensive care may be illustrated by steps which could be taken in prenatal clinics of both hospitals and health departments:

1. Provision of more extensive supervision and staffing by obstetricians and other health personnel.
2. Addition of other multidisciplinary personnel (including social workers, nutritionists, health educators) to the usual staff of physicians and nurses.
3. Provision of more complete laboratory services.
4. Inclusion of family planning advice and supplies.
5. Incorporation of public health nursing supervision into the home.
6. Specific arrangements for delivery, hospitalization, and the management of complications.

One of the present deterrents to rapidly extending comprehensive services is that of providing 25 percent matching funds. While I heartily subscribe to the principle of local communities investing in their own services, nevertheless the present tax structure of our country makes this principle very difficult to implement. This Conference might wish to give some thought to a recommendation concerning this question.

Continuity of Care

Up to the present time, the care of mothers and children has been fragmented. One would hope that we would be able to plan, develop, and provide services in such a way that continuous health and related care would be provided in one location or in a series of closely related locations at any given time for mothers and children: specifically, that early and continuous antepartum care would be available for both the normal woman and for the woman with problems; that the same staff would provide care throughout her pregnancy, labor, and delivery; that her infant would be automatically included and provided with continuous care throughout infancy, childhood, and adolescence in preparation for parenthood. One would hope that three types of care related to the maternal and child health cycle would be available in the same place by the same staff:

1. General health supervision and care for all women and children.
2. Care of special problems when they arise.
3. Maternity care, including preconceptional care care during pregnancy, labor, delivery, and the postpartum period; interconceptional care; and family planning.

Maternal and child health centers would exist which would provide comprehensive, continuous care. In order to accomplish this, certain needs stand out:

1. Each site having an M & I project should have a C & Y project. And the reverse—each site having a C & Y project should have an M & I

project. I recommend that funds be appropriated for this, and that the funding agency take steps to provide consultation to implement this objective.

2. As a corollary of this, all babies born of women cared for in any M & I project would be included and incorporated into the program throughout infancy, childhood, and adolescence.
3. There would be *no* time limit for the care of mothers after their delivery and immediate postpartum care. This would include family planning and interconceptional care in the total sense and assistance with problems of all types—medical and health, as well as social, housing, vocational, etc.
4. In a more specific vein, the problem of staff continuity would be looked at critically. Methods need to be devised so that the staff who provide care during the antepartum and postpartum periods will also provide care during the intrapartum period. I am referring specifically to the situation where, in an M & I project, a resident delivers a woman who has been medically attended by some other project physician during her pregnancy.
5. There would be at least one center for each county or group of counties where the infant mortality rate is high and where there is an excess of infant deaths.

Thus, what is beginning to be developed here is the concept and blueprint for the *MCH Center,* which will provide comprehensive care for adolescents and women of the childbearing age and for their children.

Relationship Between MCH and Family Planning

We need to look upon family planning as a part of preconceptional and interconceptional care and, therefore, as an integral part of maternal health and maternal and child health services. Perhaps an example of what can happen when family planning is separated will help to illustrate the situation.

I recently visited an M & I project which was, on the whole, a very good one. In this project, there were certain half-days of the week which were "M & I sessions"—i.e., where pregnant women could receive maternity care. In addition, there were certain other half-days where women could receive family planning information, counseling, and supplies. I asked, "What would a woman do if she came for family planning help on the day of an M & I session?" and was told that she would be referred to a family planning session which met 2 days later. When asked if she might be provided with family planning help at the M & I session, I was told that this could be done "if there was an emergency." I then asked how one defined "an emergency," and there was some consternation about this. The reverse of the above situation is also true—the pregnant woman who first comes to a family planning program is told to return on the day the M & I session meets. As part of an MCH Center, it seems to me that preconceptional and interconceptional care, including family planning, needs to be made available to all who need such care, regardless of age, marital status, economic status, etc. Thus, the

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problem of requiring parental consent for the teenager needs to be balanced against some other undesirable alternatives, such as abortion and unwanted pregnancy.

Relationships between Health Departments, Medical Schools, and Hospitals

Some thought should be given to the need to take steps in M & I projects as quickly as possible toward a joint partnership between health departments, medical schools, and hospitals. I would even recommend that in providing comprehensive care for mothers and children, health departments, medical schools, and hospitals must do this as a *joint* program. Some of the advantages which might accrue from this are:

1. An improved quality of medical care.
2. Where there are employment and salary restrictions in public agencies, such a partnership might make it possible to provide higher salaries and, therefore, make it easier to recruit well-trained personnel.
3. It might be easier to recruit well-trained personnel because of the prestige of connection with a medical school or prominent hospital.
4. There might be an easier patient referral system between the health department's resources (such as the use of the public health nursing staff for casefinding and followup) and the facility providing patient care.
5. Continuity of patient care is more likely to be promoted.
6. The staff of the M & I project will have access to the medical school and the university as a whole for their continuing education. The medical school and the university could be the major resource for in-service training of the health department staff.
7. At the same time, close involvement of the medical school and other parts of the university in M & I projects means that the service can be used for teaching purposes for medical students, house staff, and students in all of the health professions. An effective way to introduce the concept of comprehensive care, community obstetrics, and community pediatrics is through direct involvement in programs, rather than only hearing about them in the classroom.

The Special Problem of Low Birth Weight

Because of the evidence linking mental retardation with low birth weight, special attention must be given to the prevention of low birth weight. The evidence thus far provides us with certain factors associated with low birth weight. Some of these factors are:

1. *Prenatal care.* There is some evidence that the incidence of low birth weight is lower in women who begin prenatal care early and who make more frequent visits for prenatal care. However, beyond this, we have comparatively little knowledge. We do not know the role played by specific parts of prenatal care in influencing birth weight. In other words, studies are needed to determine which ingredients of prenatal care are most important in influencing the birth weight of the infant.

2. *Nutritional status.* Because of the evidence available linking nutri-

tional status, especially intake of protein with birth weight, much more effort needs to be placed on improving the nutritional status of girls and women. This effort, in my opinion, begins with the birth of the baby and should be continued throughout infancy, childhood, adolescence, and adulthood. Nutrition represents one of the best examples of preconceptional and interconceptional care. Furthermore, all individuals and services providing maternity care must concentrate much more heavily on the nutritional aspects of pregnancy. If we believe in this as an important factor influencing birth weight, food supplements need to be made available free of charge for low-income pregnant women, and the food stamp program should be modified accordingly for them.

3. *Bacteriuria.* The evidence linking bacteriuria with low birth weight should be utilized in our preventive approach. As an immediate step, all pregnant women should be screened for bacteriuria and, where positive, investigated and treated. Better screening methods are needed to identify bacteriuria. As a long-range preventive step, it would seem essential to screen the entire female population of children, youths, and women in the child bearing age for bacteriuria. We have evidence from one study in Virginia that 1 percent of girls of school age were found to have significant bacteriuria on the basis of a screening test. Thus, this represents the first step in investigation of the urinary tract for detection of abnormality and treatment of the condition. This, then, is another specific example of preconceptional and interconceptional care.

4. *Smoking.* Increased attention should be paid to the evidence linking smoking and birth weight. More experience and studies are indicated to determine such aspects as methods to motivate individuals to refrain from smoking and to identify the harmful chemicals in smoking.

5. *Previous reproductive history.* Low birth weight is part of the spectrum of unfavorable outcomes of pregnancy. Because it is, MCH Centers of the future should offer investigative and treatment services to all couples who have had an unfavorable outcome to any pregnancy, including low birth weight, fetal death, neonatal death, congenital malformation, birth injury, or residual brain damage. Couples with an unfavorable reproductive history represent a high risk for the next pregnancy. To wait for the next pregnancy, however, means a perpetuation of the continuum of reproductive wastage. Offering investigative and treatment services to this group represents another example of preconceptional and interconceptional care.

6. *Complications of pregnancy.* Low birth weight is associated with certain medical and obstetric complications of pregnancy. Because of this, strengthening preconceptional and interconceptional care and improving methods of screening and assessment of all women during pregnancy should be of assistance in reducing the incidence of low birth weight.

Manpower and the Roles of Staff

From visiting M & I and C & Y projects, it is evident that an increasing number of obstetricians and pediatricians are now involved in the community care of mothers and children. However, by and large, this involvement is limited to service in the M & I and C & Y projects only. It seems to me that some of the project obstetricians and pediatricians could be used to serve broader functions of obstetric or pediatric consultants to the State and local health departments, thereby providing help to the health departments on planning new services, inservice training of staff, evaluating the effects of services, and other policy matters. It is important for obstetricians and pediatricians in projects to recognize their potential broader role in communities, and for health departments to recognize that a nucleus staff exists who can be of even greater assistance to communities. While I have used the example of obstetricians and pediatricians for this role, it applies as well to members of the other health professions.

With our present shortage of highly trained manpower, studies and experimentation are required in order to determine the most efficient and effective use of professional staff. For example, in the maternity field, one might postulate that the most efficient use of obstetricians might include the following:

- To teach others.
- To provide care for patients of high risk (i.e., with medical complications, unfavorable reproductive histories, etc.).
- To conduct research.
- To serve as consultants to health departments in the field of maternal and child health.

If this were accepted, the immediate question to be answered is: Who would provide the care to the majority of maternity patients in communities? This would bring us to the use of the obstetric assistant (or nurse-midwife) for patients without medical complications, for preconceptional, antepartum, intrapartum, postpartum, and interconceptional care, closely backstopped by the obstetric specialist. It also brings us to the dilemma of the physician in general practice today, and of the need to experiment with methods by which he can best be prepared to fit into the maternity care patterns of communities. These questions need experimentation and study.

A third type of question concerns the best use and function of nonprofessional staff in the maternal health field. Are they only to do clerical work? Can they become helpful in early casefinding and in the referral of pregnant women to services? Do they have a role to play in counseling? Are they better used in the nonhealth aspects of maternal health? Can they be helpful with the problem of broken appointments? Here, too, more experimentation and studies are needed.

Maternal and Child Health Centers

We need one or more focal points in communities where comprehensive maternal and child health care can be provided for families. Among the services to be provided at these centers are:

1. Preconceptional care.
2. Premarital counseling.
3. Pregnancy testing for early casefinding.

4. Prenatal care. As techniques are developed, this should include the detection of intrauterine environmental abnormalities.
5. Counseling for expectant parents.
6. Intrapartum and postpartum care.
7. Interconceptional care, including family planning, and the remedial care of health complications arising from pregnancy.
8. Continuous health supervision and care of the infant, the child, and the adolescent.
9. Counseling of parents of children.
10. Family life education.
11. Genetic studies and counseling.
12. Advice and services concerning the adoption of children.
13. Services for couples with problems of infertility.
14. Counseling and management in regard to the problem of abortions, both "legal" and "illegal."
15. Services for the adolescent who is pregnant.
16. Services for those pregnant out of wedlock and their partners.
17. Provision of day care services.

Centers like this are needed in all of our large cities, and in all counties where there is a high infant mortality rate and an excess of infant deaths.

The Broad Approach

In addition to the specific details already mentioned, certain other aspects need consideration.

The first of these is the need for a family allowance system. In this, there would be a basic floor for income which would serve as the minimum for any family in our country. The basic necessities of food, housing, and clothing would be provided for. Related to this is the need for special benefits for high risk groups such as unmarried mothers. It is of interest that about half of the countries of the world presently provide a family allowance system.

There is need for regional or district planning for maternal health services so that the patient with complications will be immediately channeled to the place where the most skilled care is available. This is essential both for the health of the woman and of her future child.

Maternity care which is of high quality, comprehensive in nature, continuous, and long term in the sense that it includes the periods of both preconception and interconception, must be made available to all. This should include the continuous care of the infant, the child, and the adolescent as the first step in the maternal health cycle. As a first step, the women and children of all high risk, high priority geographic areas should be covered.

CLOSING REMARKS

MARTIN L. STONE, M.D.

I wish to thank the panelists for their succinct delineation of specific needs as related to their individual spheres of interest. I am sure that much of what they said will make its way into the specific recommendations which will be developed later in this Session. At this point—and before we reconvene for our final Session—I would like to present a brief summary of my own views.

Prematurity, it is true, represents a challenge to the basic scientists. There is good reason to believe that a tangible reduction in prematurity incidence will be achieved as a result of research—research on the fetus in utero, research in perinatal pharmacology, physiology of uterine activity, and, last but not least, in nutrition.

But, the real challenge to all of us will be to eliminate those predisposing factors associated with indigency. Among the indigent, pregnancy is a syndrome of failure—failure to stay in school, failure to return to school after pregnancy is completed, failure to use contraceptives, failure to be self-supporting, failure to establish a stable family, and failure to achieve quality performance and outcome in reproduction. Society as a whole, rather than the medical profession alone, must participate in the elimination of these predisposing factors.

Care during pregnancy—no matter how early it is started, no matter how frequently given, no matter how high the caliber—cannot reverse the deficits and deprivations of a lifetime.

FINAL SESSION

Review of Resources

Session Chairman: DR. EDWIN M. GOLD

Dr. Gold: This is our final Session. Following a "Review of Resources" to be presented by Drs. Gershenson and LaVeck, our general discussion will be devoted to the development of specific recommendations for applied and basic research for the prevention of mental retardation through improved maternity care.

RESPONSE
by

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The Maternal and Child Health Services Research Program of the Children's Bureau.

It requires a combination of faith, humor, gall, and courage to discuss a research grants program in these elegant facilities when we daily read and hear about austerity, budget reductions, cuts in domestic spending, tax increase, and urban problems. However, despite these national concerns, President Johnson made it clear in his State of the Union Message and in his Budget Message that the expansion of comprehensive maternity and infant health services has high priority. The goals of such a program continue to be those toward which the Children's Bureau has directed its energies and knowledge: the reduction of infant mortality, of morbidity, of mental retardation, of congenital handicapping conditions, and of prematurity and all its sequelae.

The Congress, in amending the Social Security Act in 1963, authorized the establishment of the Maternal and Child Health and Crippled Children's Services Research Grants Program. Subsequently, by written agreement with the National Institute of Child Health and Human Development, the Children's Bureau developed an applied research grants program, while the National Institute of Child Health and Human Development expanded basic research in reproductive biology, child health, and growth and development. This partnership between basic and applied research has enabled any serious and competent investigator to apply to one or the other agency and, at times, to both agencies simultaneously. Despite some misconceptions, Federal agencies *do* cooperate and work together, and this has been the history between the Children's Bureau and the National Institute of Child Health and Human Development.

The Child Health Act of 1967 included an expansion of the Maternal and Child Health Research Grants Program by focusing on research related to the problems of comprehensive health services, including costs, feasibility, and manpower studies encompassing research studies of training programs for all levels of health personnel, from the health aide to the physician, from the records clerk to the biostatistician, from the medical sociologist to the economist. The objective is apparent: to improve comprehensive maternal and child health services with particular emphasis on the serious problem of effective manpower utilization through the introduction of new health occupations as well as through improved interfacing of existing health personnel.

The Child Health Act of 1967 specifies that 10 percent of the authorization for child health programs for each year shall be allocated for research and training. Actually, about two-thirds of this amount will go for training and one-third for research. For fiscal year 1969, the request is for $13,300,000 and consists of $7,100,000 for new Maternal and Child Health Service Research Centers; $5,800,000 for meeting obligations on existing research projects; and $400,000 for new research projects.

As many of you are aware, these are the budget requests, and the specific amounts available for the next year will have to await the passage of the Department's appropriation bill by Congress.

Research grants are limited to public or other nonprofit institutions of higher learning, organizations engaged in research, or organizations engaged in maternal and child health or crippled children's programs. Grants are not made to individuals nor for research abroad.

Current focus is on the high priorities established by the Office of the Secretary, relating to reducing health care costs, meeting the health manpower requirements, concentrating on the health delivery systems in the slums and ghettos of the cities and the rural poverty areas.

In addition, the Bureau's Advisory Group which reviews all research applications has emphasized the need for more clinical research as well as the evaluation of new programs. Currently, we are supporting studies relating to maternity care, prematurity, inborn errors of metabolism, diagnosis, manpower, nutrition, family planning services, costs, unmarried mothers, and mental retardation.

Through a contract with the National Academy of Sciences, we are supporting the Committee on Maternal Nutrition, Food and Nutrition Board, development of nutritional guidelines for maternal and child health. Edwin Gold's research studies of high risk pregnancy, Jack Metcoff's studies of fetal and intrauterine malnutrition, the "Development of Comparable Obstetric, Gynecologic and Infant Terminology" by Edward Hughes are examples of the diversity of studies now being supported.

With the expansion of health care delivery systems by the Children's Bureau and the Office of Economic Opportunity and vendor payment systems through Title XIX of the Social Security Act, the program needs require an interfacing of research, training, and service objectives and procedures. For next year, a select number of Maternal and Child Health Services Research Centers may be established.

These Centers will have as their objective the conducting of research and training in relation to ongoing comprehensive health care services such as the Maternity and Infant Care projects, the comprehensive health services for children and youth, and the neighborhood health services. A group of three or more such service programs will form a consortium with a university and medical school to develop a research and training program related to the health service needs and problems of the ongoing community programs.

Within the university, it will be necessary for the medical school to enlist the active support and participation of the departments of pediatrics, obstetrics and gynecology, biostatistics, epidemiology, as well as the academic departments of psychology, sociology, anthropology, and economics.

The research will be neither exotic nor puerile. The research and training must be responsive to the problems faced by those directly engaged with the community of need whose cries can no longer be ignored. These Maternal and Child Health Service Research Centers are not a retreat from the community but a planned and studied effort at intervention to heal the sick, whatever their circumstance and wherever they live.

RESPONSE
by

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Public Health Service Research Support in Maternal and Child Health Relating to the Prevention of Mental Retardation.

I will review briefly the support provided by the Public Health Service for research and research training activities in maternal and child health, particularly as this relates to the prevention of mental retardation. I will not cover research and training programs conducted in Public Health Service laboratories, hospitals, or clinics as direct operations, nor will I discuss the availability of funds for demonstration and service projects.

Although the National Institute of Child Health and Human Development (NICHD) has the primary responsibility for the support of research activities dealing with mothers and children, other parts of the National Institutes of Health, including the National Institute of Neurological Diseases and Blindness (NINDB), and the new National Institute of Mental Health (NIMH), also are concerned with discrete aspects of maternal and child health. The Bureau of Health Services and the Bureau of Disease Prevention and Environmental Control support activities tangential to the problems of mothers and children. Therefore, I feel that it might be appropriate to discuss resources available through the NICHD and to insert, parenthetically, those activities germane to the mission of other components of the Public Health Service.

The basic mission of the NICHD is the support and conduct of research and research training. We support research that is aimed at helping all individuals to achieve the most normal and healthy lives possible, from conception to death. Furthermore, we are interested in normal as well as abnormal aspects of human development. We emphasize studies on methods of human fertility regulation, ways to lower this country's relatively high infant mortality rate, correction and prevention of handicapping conditions such as mental retardation, the achievement of optimal development of children, and the understanding of the aging process. Indeed, our mission is very broad. It is apparent that our concern with reproductive biology, contraceptive methodology, the psychosocial aspects of family planning, pregnancy maintenance and management, fetal development, and disorders of infancy is directly related to the purpose of this Conference.

The NICHD supports research and research training by making grants to universities and other research institutions across the country. About 80 percent of our funds are channeled into grant programs as distinct from the intramural research underway at laboratories at NIH which are staffed and supervised by Institute personnel.

Research Grants

Within the Public Health Service, the NICHD has primary responsibility for research in the biological, behavioral, and social aspects of mental retardation within the context of child health and human development. This includes basic, applied, and clinical research in both humans and animals with respect to etiology, prevention, epidemiology, pathogenesis, diagnosis, and treatment. The NINDB is responsible for investigations relating to diseases of the central nervous system which may cause mental retardation; the NIMH with studies on mental health and psychiatric disorders as these relate to mental subnormality and maternal and child health. About 11 percent of NICHD grant funds are devoted to studies directly concerned with mental retardation. On the other hand, studies on reproductive biology, contraceptive methodology, perinatal biology, erythroblastosis fetalis, congenital malformations, prematurity, and child development form the bulk of our research grant program. Although these studies may not be directly related to mental retardation, they have a bearing on its understanding. Last year, approximately 24 percent of our grant funds were allocated to studies and training in reproduction and population research, 22 percent for perinatal biology and infant mortality, 32 percent for growth and development, 11 percent for mental retardation, and 11 percent for aging.

The Institute's research program operates through the same grant mechanisms used by other Institutes at NIH. Research grants provide funds for salaries, equipment, supplies, and travel. They are awarded to universities, medical schools, hospitals, and other nonprofit institutions sponsoring research in the sciences related to health. Applications for grants are forwarded to the Division of Research Grants at NIH where they are assigned to a specific Study Section and to the appropriate Institute. The application is reviewed by a Study Section, composed of nonfederal consultants who are experts in a particular scientific discipline. Here, it is evaluated for its scientific merit, the qualifications of the investigator, and the adequacy of the research facility. After review by one of the Study Sections, the application is reviewed again by the National Advisory Child Health and Human Development Council. This Council reviews the application for its appropriateness to the Institute's mission and assigns to it a priority. This entire review process takes about 6 months.

Some typical studies supported by the NICHD are: neonatal immunity, histochemical changes associated with teratogenesis, pulmonary physiology in newborn infants, fetal distress and associated placental changes, perinatal and developmental pharmacology, mechanisms of control at gestation time, pathogenesis of respiratory distress, fertilization, implantation, steroid metabolism in low fertility, current socio-economic differences in fertility, mechanisms of fertility regulation by oral contraceptives and intrauterine devices, biochemical systems in experimental mental retardation in animals, and environmental factors in retarded intellectual development.

The NINDB has a variety of research projects directed at the many facets of neurological disorders of infancy and childhood. Many of these projects deal with mental retardation where it appears as a symptom, complication, or sequela of a disorder of the central nervous system. The NINDB is engaged in a collaborative project with 14 cooperating institutions investigating the prenatal, perinatal, and postnatal factors relating to the development of children. The "Collaborative Study in Cerebral Palsy and Other Neurological and Sensory Disorders in Infancy and Childhood" is following the offspring of more than 50,000 mothers from early pregnancy through labor and delivery until the children are at least 12 years of age. The final baby has been born to this project, and analysis of data is underway. The project should yield an enormous amount of valuable information related to mental retardation.

The Bureau of Health Services is concerned with Indian health. In the Phoenix area, a study designed to determine the cause and methods of prevention of prematurity among Indian infants is in process. A special 5-year study in conjunction with the National Institute of Dental Research, concerned with congenital malformations among Indian infants born in hospitals of the Division of Indian Health, is also underway.

Training Grants

The NICHD places major emphasis on research training of pediatricians, obstetricians, psychologists, and other investigators interested in careers in the basic and clinical biomedical or behavioral sciences, including developmental biology, biochemistry, physiology, genetics, various aspects of child development, behavioral development, reproduction and teratology, as these sciences can be applied to the mission of the Institute. We also support cross-disciplinary research training, such as training in biochemistry or genetics for physicians, and behavioral science training for pediatricians.

The principal type of support is the training grant, awarded to professional and graduate schools, to hospitals, and to eligible clinics. Training grants include funds for equipment and personnel, as well as for support for individuals in training. It should be pointed out that individuals receiving stipend support under a training grant must be either citizens or nationals of the United States, or have been lawfully admitted to the United States for permanent residence. The grantee institution is responsible for the selection of trainees who meet requirements set by the institution and NIH.

Several of the NIMH programs are directly concerned with the training of personnel who will either provide service or conduct research in the area of mental retardation. In addition, almost all programs in psychiatry, psychology, social work, and psychiatric nursing provide experience relevant to mental retardation as an integral part of the training of personnel in these disciplines. The training program of the NINDB is directed toward the development of clinical neurologists and competent research scientists in the fields associated with the diseases of the central nervous system. Particularly important are the Institute programs for the training of pediatric neurologists, who are very often required to make the initial diagnosis of mental retardation. Training programs in speech pathology and audiology are fundamental to therapy in the mentally retarded and receive strong support from the NINDB.

Fellowships

The NICHD supports training in the form of postdoctoral and special fellowships which are awarded to individuals for a year or more. Predoctoral fellowships are available through the NIMH. Foreign nationals cannot be supported through our fellowship program. Postdoctoral fellowships are awarded to individuals with earned doctoral degrees. The stipend level is determined on the basis of length of relevant postdoctoral experience.

Research Career Development Awards

Research career development awards are made to nonfederal, public or private nonprofit institutions in this country on behalf of qualified candidates. Development awards enable institutions to finance positions for qualified individuals who have 3 or more years of relevant postdoctoral research or professional experience and have demonstrated research ability or potential. Awards may be made for an initial period of 5 years, subject to an additional 3-year renewal.

Contracts

The NICHD and other Institutes also have the authority to enter into contracts with nonprofit institutions to conduct research at the request of the Institute. In these types of projects, the NICHD staff participates in and directs the research activity.

Conferences

The professional staff of the NICHD uses scientific consultants individually or, more frequently, in small interdisciplinary groups, to review specialized problems and identify neglected areas of research and training which should be promoted by the Institute. An example is the June 1966 Conference on the Prevention of Mental Retardation Through the Control of Infectious Diseases. The proceedings of this Conference are now in print. Publications from similar conferences include *Sudden Death in Infants, Initiation of Labor,* and *Neonatal Respiratory Adaptation.*

Construction

An activity of great significance to a successful attack on mental retardation is the construction of research centers made possible under the Mental Retardation Facilities Construction Act of 1963. The research centers are administered jointly by the NICHD and the Division of Research Facilities and Resources of the National Institutes of Health.

To date, 12 centers, nearly all in university settings, have been funded at a total Federal cost of nearly $26 million. Our Institute will assume primary responsibility for the funding of meritorious projects when the centers become operational, although other parts of the Public Health Service, as well as other agencies in the Department of Health, Education, and Welfare, will undoubtedly support activities in these centers. Six centers are planned for operation and occupancy in 1968, two more in 1969, three more in 1970, and all 12 by 1971.

University-affiliated facilities for the mentally retarded are administered by the Division of Mental Retardation of the Social and Rehabilitation Service. NICHD concern here is with the research and research training components conducted in these facilities. Many of these facilities have been established jointly with mental retardation research centers. We intend to fund research and research training projects carried out in these university-affiliated facilities.

In summary, the NICHD and other components of the Public Health Service support research, research training, construction of research facilities, and conferences in maternal and child health that are relevant to the prevention of mental retardation.

GENERAL DISCUSSION

Dr. Gold: Before we embark on the general discussion leading to our specific recommendations, I would like Dr. Clifford, who is chairman of the ad hoc committee for recommendations regarding terminology, to present his committee report and the recommendations that his committee developed with regard to its accessory charge relating to tabulation of statistics in an attempt to secure some unity in such tabulations.

Dr. Clifford: The ad hoc committee decided, subject to your approval, that rather than have intermediate terms such as prematurity, low birth weight, immature, and so forth, which, in turn, have to be defined, what we really need is to have a primary description of exactly what we are talking about. Therefore, the ad hoc committee recommends "that descriptive terms such as prematurity and low birth weight infants be abandoned in favor of the specific designation of both birth weight and gestational age, i.e., 2,500 grams-36 weeks, or 3,500 grams-40 weeks. (For convenience, if through usage the weight was always mentioned first, then it could be given in hundreds and, thus, the above example would be a 25–36 or a 35–40 infant.)

The second item with which the ad hoc committee concerned itself relates to the tabulation of reliable statistical information, whether it be of the Lubchenco or the Yerushalmy type. The committee felt that such information could be obtained from the National Center for Health Statistics if they would compile such statistics according to the following recommendation:

Recommendation for the Tabulation of Statistics Concerning Fetal Deaths, Live Births and Neonatal Deaths

Birthweight Grams	Weeks Completed, dated from L. M. P.												
	20–	21–	22–	23–	24–	25–	26–	27	etc.	40–	41–	42–	43+	Unknown
1000 & under														
1001–1250														
1251–1500														
1501–1750														
1751–2000														
2001–2250														
2251–2500														
2501–2750														
2751–3000														
3001–3250														
3251–3500														
3501–3750														
3751–4000														
4000+														
Unknown														

Separate Tabulations would be developed for:

White—Single Births) +
Non-White Single Births) Total
White—Multiple Births) +
Non-White Multiple Births) Total

Since a new birth certificate is being adopted this year, and since 40 States will have the information dating from LMP, the committee felt that the above tabulations by weeks of gestation would be readily available. It is hoped that statistics in the detail noted could be made available starting in

1969. The reliability of such data would be ensured, and this would be a most valuable source of information from the data collected by the National Center for Health Statistics.

It is further suggested that the above recommendation be addressed to the Children's Bureau, the National Center for Health Statistics, and the National Institutes of Health.

DR. GOLD: I will take the prerogative of the chair to read a brief statement which will serve, perhaps, as the basis for the general discussion.

In order to achieve continuity in the deliberations of this Conference, I propose that the following recommendations emanate from this National Conference:

1. That this group be constituted as an expert panel on maternal health and family planning to serve as a consultant group to the National Institute of Child Health and Human Development and to the Children's Bureau in order to implement the following recommendations from this Conference.
2. That the standards and content of good maternity care be redefined.
3. That Federal support be provided to evaluate the influence of nutrition on maternity care and outcome of pregnancy.
4. That existing legislation applicable to maternity and infant care be broadened, and that additional funds be provided to enable comprehensive longitudinal care of mothers and infants, and that such care be extended to include interconceptional and family planning care of the mother, and care of children and adolescents to insure their optimum health, preconceptionally, in order to reduce infant mortality and mental retardation, and to generally improve the quality of human reproduction in this country. This is, in essence, the blueprint for the Maternal and Child Health Center.
5. That an effective program to evaluate the quality, content, and efficacy of such total maternal and family planning services be developed.
6. That subsequent meetings of this panel be scheduled to review progress made in carrying out these recommendations.

DR. J. D. THOMPSON: A terrible syndrome is going on in this country concerning the problem of improving maternal health. And the syndrome is this. Several people get together and decide that a problem exists. The next question is, what shall we do about it? Someone suggests a conference. So, all the other people in the country who are also interested in this problem are invited to a conference where, for several days, they sit around and tell each other how terrible this problem is. At the end of the conference, a summation is made and the same words are said: "This is a terrible problem." Then everybody goes home but, somehow or other, they feel better about it—until they gradually start feeling bad again. Then they have another conference.

But nothing ever comes of these conferences in the way of specific recommendations and action for several obvious reasons. First of all, the subject matter being dealt with is entirely too broad to make any specific recommendations about what should be done. Certainly, recommendations that are good ones have been carefully considered, carefully worded, particularly with reference to the questions of how these recommendations shall be im-

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plemented and what kind of far-reaching effects they will have beyond our own areas of competence.

I am also disturbed by a very serious lack of long-range planning in maternal care. Maternal health has been tied to the coattails of several other major health care efforts, and we have benefited from that to a certain degree. We have, for example, been included sometimes under the umbrella of mental retardation efforts. But a look at the mental retardation research and training centers will reveal little in the way of concern for the reproductive process. Comprehensive State plans for mental retardation do not contain detailed, specific, and well thought out recommendations for improving maternal health. Basically, what we have done in our mental retardation effort is to increase the concern and effort for the study and care of mentally retarded children. I am for helping mentally retarded children—but there is a difference between mental retardation and the mentally retarded child. If you are talking about mental retardation, you must talk about prevention, and that certainly includes concern for the quality of human reproduction. I repeat, maternal health and maternal health care have benefited by being included under the umbrella of mental retardation, but we have not benefited to the extent that we need, or to the extent the expectant mother and her unborn child need to be benefited.

Insufficient emphasis is being placed on maternal health care in the design of the regional medical programs that are going on throughout this country. It is entirely possible for these plans to be well underway, and perhaps even completed, without the first consideration being given to the need to improve the quality of human reproduction. The Office of Economic Opportunity has helped to improve maternal health in a few ways, but I wonder how much more could be done. We have legislation for comprehensive health planning in States and communities, but where is there sufficient emphasis on the quality of human reproduction? A number of State committees concerned with comprehensive health care have been appointed, but a look at the people on the committees makes it perfectly clear that the expectant mother will not be included in the plans.

We cannot solve the special needs of the expectant mother, the expectant family, the expectant community when we continue to find ourselves under somebody else's umbrella. Nothing is more important to this Nation than the quality of its human reproduction, and I suggest it is time for us to have our own major national effort in this area.

It would, therefore, be my recommendation, Mr. Chairman, that this Conference recommend to the President of the United States that he appoint a President's Panel on Maternal Health and Family Planning which would make recommendations and suggest the ways in which the goals of these recommendations should be implemented. In my judgment, this is long overdue. I feel that the President would consider this recommendation favorably.

Dr. Hunt: I appreciate Dr. Thompson's timely and forward-looking proposal. We do not want to regard the female population of childbearing years together with the child population as a small issue. Actually, this is a major portion of the population of the United States, and the health of the entire Nation depends greatly on the health and welfare of these groups.

Dr. Lesser: As a matter of procedure in relation to what has already been initiated, I would suggest that we relate this discussion to the President's Health Message and to the Child Health Improvement Act of 1968. But, in the details of this, it is clear that basically all of the provisions of this Act would be to provide improved maternity care for virtually all of the women of low income who are in need of such care, not only to provide quality care for them, but in order to improve the outcome of pregnancy. Thus, it seems to me there would be advantages in relating these discussions to steps being contemplated by administration, and I would therefore suggest that we include the infant in any title.

Dr. Gershenson: I believe there is a need for some clarification concerning what goes on in Government in terms of what is meant by a panel. Let me describe this. There are three different types of operations, and it is not clear to me what Dr. Thompson has in mind.

One, the President has appointed approximately 30 task forces in the past few years—one in child health, one in child development, etc. They meet for a period of time, ranging from about 6 months to as little as 2 weeks, at the end of which they suggest specific legislative recommendations. Then they are through. Secondly, there is something which has Congressional action, such as the Joint Commission on the Mental Health of Children which has been extended to a third year. They will suggest specific recommendations at the end of the 3 years, and then they will be out of existence. Thirdly, there is a continuing panel, such as the Mental Retardation Panel, and I believe this is what Dr. Lesser was referring to. You would have, I feel, much more impact if whatever you want to recommend is tied in with some legislative program. It may be that what you require will call for legislative action. Otherwise, if it is just in terms of a Presidential appointment, it will be only on a time-limited basis.

Dr. J. D. Thompson: Dr. Gershenson, I appreciate your clarification and your questions. What I had hoped would happen here would be similar to what happened in the area of cancer, heart disease, and stroke, and in the area of mental retardation originally. The terminology and the mechanism by which this can be done I leave to the experts. If this wording should be changed in some way in order to accomplish that end as I described it, then I hope you will suggest the appropriate terminology. Or it may be that our discussion is sufficient at this point to clarify what it is we have in mind. I am willing to accept Dr. Lesser's suggestion that this be a panel on maternal and infant health. I assume that the President's Panel on Children and Youth, for example, may not be dealing with the health needs of the infant. On the other hand, if there is a panel already working in this area, then I would prefer the designation of maternal health and family planning.

Dr. Gold: In recapitulation, the following recommendations were developed by unanimous accord of the participants in this National Conference for the Prevention of Mental Retardation Through Improved Maternity Care:

1. That the President of the United States appoint a President's Panel on Maternal and Infant Health and Family Planning to determine national goals and to make recommendations concerning the achievement of these goals and the implementation of these recommendations. This panel should serve on a continuing basis.

2. That the standards and content of good maternity care be redefined.

3. That existing legislation applicable to maternity and infant care be broadened, and that additional funds be provided to enable comprehensive longitudinal care of mothers and infants, and that such care be extended to include interconceptional and family planning care of the mother, and care of children and adolescents to insure their optimum health preconceptionally in order to accelerate the reduction of infant mortality and mental retardation, and to generally improve the quality of human reproduction in this country.

4. That Federal support be provided to evaluate the influence of nutrition on maternity care and outcome of pregnancy.

5. That an effective program to evaluate the quality, content, and efficacy of total maternal health and family planning services be developed.

6. That subsequent meetings be held to review progress made in carrying out these recommendations.

7. That the staff of the Children's Bureau and the National Institute of Child Health and Human Development review the proceedings of this Conference to implement the specific recommendations made.

I thank you all for a wonderful conference—for the work, sincerity, and dedication that you have rendered to each of us, to the two sponsoring agencies, and to the mothers, infants, and children of the Nation.